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PHYSICAL PROPERTIES OF DENTAL MATERIALS*

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IN 1919, the National Bureau of Standards was asked to assist one of the government departments in grading or selecting satisfactory amalgam alloys for its use. To Mr. Chauncy Peters and myself were assigned the problems of testing and recommending specifications for amalgam alloys. The results[1] of this investigation were made public, as far as it was possible to do so in 1920. I hope to review briefly some of the material contained in these papers.

The reports on amalgam were favorably received, and numerous requests were made by individuals and organizations that the research be extended to include the problems met in the use of the gold alloys. Our director, Dr. S. W. Stratton, tried to allot our funds in such a manner as to include the tests requested but was unable to do so. He then suggested to the organizations the possibilities of getting the work done by one or more research associates, to be stationed at the Bureau, who would have the facilities of the Bureau's laboratories and the benefit of the advice of its scientific staff.

Of the organizations interested only one, the Weinstein Research Laboratory, agreed to the conditions of such an arrangement. The research on gold alloys and problems connected therewith was accordingly started with the cooperation of this laboratory, Jan. 16, 1922. The important details of the arrangement are:

1. The cooperating laboratory pays

*Cooperative Research by the National Bureau of Standards and the Weinstein Research Laboratories.

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1. Souder, W. H., and Peters, C. G.: Bureau of Standards Technologic Paper No. 157, 1920; An Investigation of the Physical Properties of Dental Materials, Dent. Cosmos, 62: 305 (March) 1924.

the salary of the associate or associates, provides all special equipment and supplies funds for purchasing materials to be tested.

2. The Bureau provides space and the regular equipment needed, supervises the work and makes public the results obtained.

The Bureau of Standards, one of the newer bureaus (established 1901) is under the Department of Commerce. Mr. Herbert Hoover is the secretary. Dr. Stratton, the first director, directed the affairs of the Bureau until 1923. He was succeeded by Dr. George K. Burgess, one of the senior members of the Bureau. I mention these facts to give you some idea of the unified spirit and accord in this bureau. Our functions are varied, as you may expect. The function which covers the work that we are now considering comes under the following quotation from the Organic Act of 1901: " . . . the determination of physical constants and the properties of materials, when such data are of great importance to scientific or manufacturing interest and are not to be obtained of sufficient accuracy elsewhere."

There are approximately 500 members on our scientific staff.

Let me remind you of some of the results of Bureau researches:

1. The brake linings of automobiles now last three or more times as long as they did five years ago. The money-saving result of this research in labor and material is $15,000,000 a year.

2. Flashlight batteries now last longer.

3. Defective enamel ware is less commonly seen.

4. Approximately, 100 tons of steel will be saved in constructing the Delaware River bridge.

5. The complaints between auto manufacturers and petroleum refiners have practically disappeared. Supplies of bad gas or motor troubles are being forgotten.

6. Cord tires are replacing fabric tires.

7. We may expect that auto manufacturers, ice companies and tent makers will soon paint their covers with a metallic paint to produce cooler conditions on a hot summer day.

8. Radium salts are now sold with accurate value certificates attached to each lot.

These are only a few results of the activities of the Bureau of Standards. Whether your profession is to be benefited in a similar way by this cooperative research depends on the answers to two questions: first, are there chances for improvement in materials or in technic? and, second, how far will you advise and cooperate? I shall answer the first question. I cannot answer the second.

I am not unmindful of your many research laboratories and I am sure you will be encouraged to continue and enlarge their scope when we discuss for a few minutes apparatus, test methods and results.

I have promised you a brief review of the amalgam research. In 1919, when called on to render service in selecting proper amalgam alloys, the Bureau searched the literature for a definite standard but was unable to form final conclusions as to what was really essential. I do not hesitate to say that the recommendations of Dr. G. V. Black were of much greater value to us than those of any other author. However, there appeared a necessity for additional and more precise data. I shall mention only one example: the thermal expansivity of the tooth substance and the amalgam. If these values are widely different, there must be means for correcting the defects that would be expected by reason of the temperature changes produced by hot or cold foods.

We were unable to find any data on these items. In a few days, we had specimens selected and were able to report a value of 25×10^{-6} or 25 millionths as the value for the amalgam

alloy, and a value of approximately 8×10^{-6} or 8 millionths for the tooth. Our values for amalgams have been verified by data published later. We have no knowledge of anyone attempting to verify our work on natural teeth.

The effects produced by temperature variations in these two substances, you will observe, are very serious, one substance having a coefficient twice that of steel and one about two-thirds that of steel. An engineer designing a structure or a precision machine with materials so divergent would plan for some method of compensation. Fortunately, a number of amalgams possess the property of expanding on crystallization. This expansion pushes back the elastic tooth substance and stores up sufficient resiliency to keep the cavity sealed under all normal conditions. This expansion on crystallization is most essential, for, to secure this result by continued pressure on the plastic amalgam does not appear practical. The malleted gold or the rigid gold inlay inserted with a film of quick-setting cement secures the same results.

Perhaps you have never taken the trouble to reason out why Dr. Black insisted on a certain number of "points" as he called it, of expansion. An elementary computation, which need not be made at this time, will prove that 1 to 5 microns per centimeter will care for most conditions met in the mouth. This is not essentially different from the value recommended by Dr. Black, perhaps from empiric rather than theoretical data. Our proposed specification recommends an expansion of 4 microns per centimeter as the best value.

The Bureau made comparisons for crushing strength, flow, electromotive force, blackening, solubility and a number of other qualities. The findings on solubility and electromotive force were definite but of relatively little consequence; hence, no recommendations on these items were made in the specification. The previously mentioned references give details of data and apparatus. A copy of the proposed amalgam specification was mailed to the various laboratories and individuals cooperating. As soon as the dental schools and research laboratories install the precise equipment or even the cheaper equipment recommended, the defective alloys will disappear. My statements must not be too bold, but I feel sure some school has not trained its graduates to a full appreciation of the value and methods for determining the physical properties of dental amalgams, or there are some dentists too old to learn. I wonder if that school or those dentists will receive the report and recommendation on gold alloys in the same spirit.

Let us now pass to the problems connected with the production and manipulation of gold alloy restorations, attachments, etc. Although an enormous amount of work has been done on this problem, and numerous articles are now in print, I believe some of you are still uncertain regarding some one or more phases of the technic or regarding the material. I assure you I am; but many difficulties are clearing up.

You do not have to read long to discover conflicting statements regarding wax manipulation, investment strength, gold segregation, gas or oxid content, heat treatment or chemical composition. These conflicting statements were pointed out by Dr. Weinstein at the time the research was started, and it was understood that an attempt should be made to find the facts and report them without fear, favor or influence. While this is only a progress report, it is not to be assumed that the results reported are faulty or uncertain. Rather, you may not expect an elaborate report at this time. The articles now in preparation should appear in print in a few weeks and will supply the more elaborate details.

Some of the results are:

The usual plaster silica 30-70 investments expand slightly, say 0.2 per cent when heated to 300 C. After passing

300 C., they begin to show shrinkage even though the temperature continues to rise. If allowed to cool to room temperature, they show further shrinkage.

The approximate strengths of the usual investment when subjected to the ultimate compressional test are: at 200 C., 175 pounds per square inch; at 300 C., 245 pounds per square inch; at 500 C., 260 pounds per square inch. These are the values when the plaster silica is crushed hot; the same conditions as you have when you cast gold into the hot mold. Investments once heated and allowed to cool are decidedly weaker, averaging about 80 pounds per square inch when crushed at room temperature. We have used extreme care in cooling slowly, in fact reducing the temperature gradually for a period of twenty-four hours, but we cannot prevent the 70 per cent loss of strength on cooling from 300 C. or higher.

Straight plaster of Paris mixes show the same phenomenon of contraction if heated above 100 C. The crushing strengths are: crushed at 200 C., 525 pounds per square inch; at 400 C., 605 pounds per square inch; at 500 C., 620 pounds per square inch.

We were not able to preserve a single specimen intact cooled from 500 C. The disintegration on cooling is most surprising. Many have thought of it as accompanying heating.

I am not condemning any technic. I am stating facts. Perhaps you will feel the dimensional changes and strength depreciations are not serious. I am not supposed to decide that question.

Data, or rather claims, as to oxid content of gold alloys may lead us to expect serious defects in all but a few alloys. The Bureau's gas analysis of some alloys manufactured in the usual way and supposed to contain oxid show oxygen content of 0.0013 per cent. The oxygen content for a gold alloy containing 10 per cent copper was found to be nil. Alloys made by the granulation process, that is, pouring the molten metal into a liquid bath, show 0.0025 per cent and 0.0026 per cent oxygen content; or approximately twice the content of the regular crucible melted and poured gold. These data are from actual manufacturers' products and not from experimental or special mixes. This again must not be considered a condemnation of oxid or of the method of manufacture. The only point to be made is that if golds can be manufactured by the usual processes, which show little or no oxid, there is little occasion to be too insistent about some special method of melting or casting the original ingot.

The serious phase, if any, comes in the contamination that the gold receives when melted in the laboratory with the usual blowpipes and flames. We find that our oxygen inclusions run as high as 0.0150 per cent oxygen for five remelts. We hope to give more definite data on blowpipes at a later date. Melts of originally gas-free alloys made in an electrical induction furnace, using high frequency electrical alterations, showed oxid additions of 0.0289 and 0.0471 per cent, and for the 10 per cent copper alloy 0.0116 per cent oxygen. This was made in the furnace, not evacuated.

Let me remove any apprehension regarding the oxid by reminding you that a small percentage of copper oxid in copper hardens the material. It remains to be proved, as far as I know, whether a small percentage of oxid in a gold alloy may not do the same. Our tests have not yet included this phase.

I cannot give you much information on segregation of alloys at this time. Our tests have been qualitative only, and it will require more refined tests to locate segregations, if present, when using gold alloys as they are generally used or should be used.

Do not get the idea that it is impossible to injure or contaminate to a serious degree these alloys. Later, we hope to try some of the abusive or "stunt"

technics and shall doubtless be able to report serious injury.[2]

I trust this progress report has been of interest to you and will start you thinking. Will you please record your conclusions, and suggestions on paper.

A number of members of this organization are actively corresponding with the Bureau and offering valuable suggestions. We naturally consider these men to be the leaders in the profession. However, the list is not closed. Your suggestions will receive careful consideration.

I am sorry to have to state that we shall not be able to answer all specific questions at the time they are asked or immediately on our discovery of the answer. You realize that such action would ruin our policy of making the results available simultaneously to all members of the profession. Once we start announcing or discussing preliminary results we shall be deluged with visitors and correspondence from those who want special favors and advance information. You will respect us for this policy, I am sure.

DISCUSSION

M. Weinstein, New York City: Dr. Souder has presented for your consideration definite facts. There is no question as to their accuracy. I shall endeavor to discuss some parts of the report that might be emphasized to advantage at this time.

I should like to refer for a few moments to the origin of this research. As many of you are no doubt aware, I have, for a number of years, carried on work of this character in a more or less crude, and perhaps amateurish way. Despite some approval and recognition, more or less deserved, I have always felt that my results were comparatively indefinite—they lacked scientific corroboration. This was not strange because there were no scientific standards to follow; there were no data on dental metallurgy worthy of the name, and less on physical constants or methods of determining such constants on alloys in the small dimensions such as we employ in dentistry.

I was particularly handicapped in my work of developing new alloys for the increasing demands of various dental processes. While standard methods and equipment for testing industrial alloys in the dimensions used in industrial engineering were available and were of relative value, it was next to impossible to apply them with a sufficient degree of accuracy to specimens of dental size. The tensile strength of orthodontia wire could hardly be tested by the methods that apply to iron, steel, brass, bronze and other industrial alloys. The resiliency value, fatigue resistance and effective life of gold alloys for wrought or cast clasps certainly could not be tested and determined in the same manner as automobile springs.

For a time, I hoped that the research activities of the American Dental Association would include work in the metallurgic field and its relation to dental prosthesis; but as you know, its activities were directed principally to the investigation of other important dental problems. I endeavored to interest certain educational institutions in work of this character, but received little or no encouragement.

The situation seemed rather hopeless until I became acquainted with the work the Bureau of Standards was accomplishing in the amalgam investigation. The character of this work impressed on me most emphatically the possibilities and value of similar work in the broader field of metallurgy as applied to prosthesis, and I was one of those who repeatedly urged the director of the Bureau to extend the work and take up other dental problems.

Subsequently, my proposal of a cooperative research was accepted, and this was the beginning of an invaluable experience, invaluable because of the knowledge I am gaining.

The Bureau's facilities and equipment for scientific research are unsurpassed by those of any institution in the world. The 500 men at the Bureau work all the time and for the love of science alone. The compensation they receive is much less than they could earn elsewhere. The personnel of the Bureau from the director down has shown a remarkable spirit of helpfulness, cooperation and encouragement. A number of men in different departments have contributed their efforts and aided very materially in the prosecution of the work.

Dr. Souder, in charge of this work, and Mr. Coleman, the senior full-time research associate, have grasped and mastered the relation of dentistry to the work assigned to them, which is not so strange when you consider their scientific training. The significance of this special capacity on the part of Dr. Souder and Mr. Coleman should be of special interest to dental educators.

The science of metallurgy in all its aspects

2. At this point, Dr. Souder presented and discussed the data and illustrations of the paper by R. L. Coleman, Jr., (page 520, this issue).

plays a very important rôle in the construction of dental restorative and corrective appliances. A thorough and definite knowledge of this subject is of paramount value to the dentist. The dental profession is intimately concerned with perhaps more of the arts and sciences then any other profession. The dentist must be a physician, a surgeon, an engineer, and last but not least, a skilled technician. Even if he relegates the actual construction of prosthetic appliances to assistants, it is still imperative that he have a thorough knowledge of the engineering principles involved in order intelligently and effectively to direct the work.

Who ever heard of an engineer undertaking and directing the construction of a building or a bridge or a railroad without first making a definite specification of the design and materials to be employed? The engineer must know the chemical, physical and mechanical properties of his materials. He must know the behavior of these materials in the raw state as well as in the fabricated state; how they should be manipulated, and what strains and stresses the structures can, and must, withstand in ultimate service. The planning and construction of dental restorations is an engineering problem, on a minute scale, to be sure, but fully as important to the public welfare as buildings, bridges and railroads; perhaps more so if the nation's greatest asset, public health, is considered. If this is true, then dental engineers must also have definite standards.

It is obvious that this research will establish the desired standards and place dentistry on a higher plane than ever. I feel confident that the results will mean much to the profession and those allied with it. It will not only definitely establish the properties of the materials available, but suggest improvements and better manipulative technic, and economies in time as well as in materials. It will reduce guesswork and empiricism, and increase accuracy and precision in our technical procedures.

Advancement in practically all industrial and technical processes is the outgrowth of fundamental scientific research. The present research should be the basis of advancement in the technical processes in the field of dentistry, but it must be practically applied to the problems encountered by the dentist. The data established in this research is only a mere beginning and far more will come. It will be the duty of men with adequate training in both dentistry and the related sciences to teach the application of these fundamental findings, and make the dental interpretation both clear and useful to the dentist at large, so that the results may effectively benefit him in his work.

But a small part of the work accomplished in the past three years can be covered by Dr. Souder in the short time available this evening.

This is only the beginning. We are now working intensively on casting problems and alloys and are accumulating data perhaps of even greater interest to you. Publication will be made in the shortest possible time consistent with the high standards of accuracy maintained by the Bureau.

Thomas G. McMahon, Chicago, Ill.: A keen interest on the part of the dental industry in this scientific investigation has recently made itself manifest.

This research work was started and directed by Mr. Weinstein, in January, 1922, and about one year later, it was offered to the American Dental Association through its research commission.

The dental industry was not approached before that time, at that time nor at any other time, to my knowledge, concerning whether or not it had a desire to cooperate in this research.

Dr. Souder stated that, of the organizations interested, only one, the Weinstein Laboratory, could see its way clear to agree to the conditions of such an arrangement. So far as I am able to learn, the dental industry did not know that the Bureau of Standards was negotiating with the American Dental Association or anyone else concerning this matter, and it was not until March, 1924, I believe, that the dental trade first learned that this research work was going on at Washington. Perhaps we may have been asleep at the switch, but it was felt then that this was a matter in which the dental industry should interest itself, and therefore a special dental industry committee was appointed to investigate the investigation with a view of either continuing the research work or joining with the American Dental Association in its continuance, if the benefits to be derived by the American Dental Association were thought to be sufficient to justify the expense, which in round figures will amount to approximately $50,000 when the work is completed.

Now, I realized that in order to discuss Dr. Souder's progress report with any degree of intelligence, it would be necessary for me to see a copy of it in sufficient time before this meeting to study the Bureau's findings, in order to ascertain as nearly as possible the value to the American Dental Association of the work that has been done, and I qualified my acceptance accordingly.

I think it is only fair to state that after repeated efforts on the part of members of your Association by your president and others, as well as my own efforts, which included a trip to Washington and some assistance from the Assistant Secretary of Commerce, I did not

get more than a hurried glance at it, for which I am deeply indebted to Dr. Souder. The day I left Chicago for Dallas, however, I received a fair outline of what Dr. Souder has presented here tonight. I have no desire to convey an erroneous impression. I was neither offended nor alarmed over the delay, which I am sure was unavoidable, but merely offer this explanation by way of apology for not coming more to the point on the scientific end of this discussion, which, on the contrary, as will be noted, deals with the practical point of view as seen by the industry.

I hope that anything I may say will not be construed as indicating that the dental industry does not fully appreciate the value of the experimentation and research work that has been done in this case. We are well aware of the fact that a report of this kind does not nearly reflect the great amount of untiring effort that it represents because the results of the major portion are scrapped so to speak and never get into public print.

It is merely my idea to place before you some thoughts in connection with the work that is going on at the Bureau of Standards, and if it is possible, to compare progress that is being made there with the progress which has been made and which will continue to be made by the dental profession and the dental industry cooperating with one another along scientific lines.

It is well to consider the fact that many manufacturers have for years been doing considerable research work, which we all realize is quite expensive, and hundreds of the members of your profession are constantly doing research work, which also consumes considerable time and expense. Therefore, it would be well to analyze the subject before us tonight with a view to avoiding a duplication of effort and expense.

We have a big subject here, and if we can size up our present-day situation correctly and compare it with what we can look forward to, it will give us some idea as to how to proceed.

There is probably a great deal more experimental and research work being done by the dental manufacturers than most dentists realize. In my conversation with various manufacturers, I have been pleased to learn that so many of them appreciate the importance of research work. There is enough competition among the various manufacturers to keep them all on their toes.

It might not be amiss for us to realize that scientific research has been the basis of most all of the development of materials used by the dental profession; also that this research work is carried on in constantly increasing volume and is the basis of all competition in the dental industry.

In the past, producers of precious metal alloys were not drawn on as far as scientific research is concerned, to such a great extent as has been the case since the introduction of dental castings for the larger and newer types of restorations, as well as of the more recent methods of orthodontists, which have created a demand for better metals, with definite physical properties.

Today, the matter of being in a position to supply the demand for specific physical requirements is very necessary and important to all dental gold manufacturers. In the production of casting golds, the casting properties are important; but when a casting is completed, the metal must possess the definite physical properties that the nature of the case requires. It is the manufacturer's duty to study these requirements and produce the materials with which to fill them properly.

It is next to impossible to develop good materials without experimentation and research work; therefore, it is only fair to predict that the days of usefulness to the dental profession of any manufacturer who does not realize this are numbered.

I know that many of the manufacturers of precious metal alloys have research departments, but I am not familiar with the entire scope of the work they are doing. It is known that they are making scientific tests for hardness, elastic limit, fusing points, tensile strength, reduction of area, elongation, fatigue, torsion, oxidation, carbonization and segregation; also micrographic studies and the application of various heat treatments in connection with these physical tests.

I am advised that the wax and investment manufacturers have done a great deal of research work, as well as the manufacturers of many devices that are being used by the profession today. Just how far-reaching this work is, I am not prepared to say; but this could easily be determined.

I am glad that Dr. Souder has brought out the fact that the oxid scare has been much overdone and has laid trouble at the door of contamination, also that he points the finger of suspicion toward the various blowpipe flames and the manner in which they are used.

We believe heat treatment of the complex alloys is a big subject and that there is still much to be learned in this direction.

We do not believe segregation of well alloyed metals is causing any great amount of trouble.

The conclusion that I would draw from what Dr. Souder has said and shown is that when lack of efficiency is made manifest, it is due more to faulty technic than to imperfections in the better grades of materials and devices used, excepting, of course, the various gases used for flames in melting.

With all due consideration to the excellent

work that has been done at the Bureau of Standards and its possible beneficial effect as to the dental profession, it would seem that, in making a decision as to whether the profession, or the industry or both organizations jointly, shall enter this cooperative research with the Bureau of Standards, it would be a mistake to assume that great progress has not already been made under the splendid cooperative spirit that now exists between the profession and the industry.

One need go no farther than reading the articles published monthly in THE JOURNAL OF THE AMERICAN DENTAL ASSOCIATION, and other dental journals, and visiting the clinics at the national, state, district and component dental society meetings, to see the beautiful and highly satisfactory results that have been obtained with the materials and devices now made available by the hundreds of brilliant men in your profession who have so unselfishly given their time, energy and funds in the development of this work. I am sorry that time does not admit of mentioning the names of all of these gentlemen and paying sufficient tribute to them.

Again, if I am rightly advised, it is the intention of your president to throw this subject open for general discussion, and it seems to me that the things to be considered are as follows:

1. Is or is not the dental profession making satisfactory headway in the art of dental casting and the application of orthodontic appliances?

2. Are or are not the reputable dental manufacturers supplying the dental profession with as good materials and equipment for their use in casting and orthodontia work as they should? Has the trade been lax in this respect? Is the trade doing enough experimentation and research work to place them in a position to develop and manufacture materials of sufficient quality to meet the ever-changing requirements of the dental profession?

3. Considering the personal element that enters into the manufacturing and use of the numerous materials required by the dental profession, could any standard be set that would produce uniformly good results? Does the dental profession and dental trade want to have standards set for them to follow if they have had no voice or hand in the setting of these standards?

4. Would it be practical to have the Bureau of Standards conduct research work on the hundreds of materials and devices now being used by the dental profession?

5. How much benefit has the dental profession derived from the scientific research work done at the Bureau of Standards on dental amalgam? Has this research work caused any change in the manufacturers' formulas or processes of making dental amalgams? Has the so-called modern amalgam technic, as advocated by many of the leading amalgam operators, been changed to any extent as the result of the Bureau's research work?

So far as the continuance of this cooperative research is concerned, we are advised by the Department of Commerce (under which the Bureau of Standards functions) that they prefer to have the cooperation of an industry rather than an individual. Therefore, the dental trade awaits with interest an expression of the attitude of the American Dental Association concerning this research investigation, and I am sure that the Bureau of Standards would likewise desire to be advised as to the decisions of both organizations.

I should like to make it clear that it would be obviously fatal to the welfare of the dental industry to suggest anything that is not to the best interests of the dental profession. We are all thoroughly convinced that no selfish motive will ever succeed. Therefore, if we are to be successful, the interests of the profession must come first.

L. L. Barber, Toledo, Ohio: This is the thirty-third consecutive meeting of the American Dental Association that I have attended, therefore I am not coming before you as a novice in the dental end of this question. In the first place, I want to tell you a little about my impression of the Bureau of Standards.

I have made a trip to the Bureau of Standards, and I received very courteous treatment by the men in charge. Mr. Souder accompanied our committee and went over everything that he had time to examine and showed us the work that they were at liberty to show us. We examined or were shown the facilities that they have for working out all of these problems, and it seems to me they cannot be excelled any place in the country—the facilities, the apparatus and the earnestness with which this department is striving to get real results.

Tonight, I have learned one thing, and that is that the people must have automobiles even though they do not have teeth. They have done an immense amount of work on automobiles, which is all well and good. Now they do not do this work without expenditure of money. The automobile industry has spent an immense amount of money to develop a better automobile. Isn't it quite as important that the dentists of this country should spend any amount of money that is necessary to develop better material for the benefit of humanity?

I want to say something about the importance of a real connection between the American Dental Association and the Bureau of Standards. It seems to me that it is the

best possible available place where we can arrive at certain conclusions and get them without any bias or selfish motive whatever. I am very anxious that this Association make a good working arrangement with the Bureau of Standards. That cannot be accomplished without the expenditure of money, that is true. But we spend money for everything else. We pay for all of the experiments that the dental manufacturers are making, and it is just that we should, within a reasonable degree.

There was a time, gentlemen, when sugar was to every groceryman a necessity, and he sold it. Gold, to the dental supply houses, used to be as the sugar to the grocery store; now gold to the dental supply house is, as I believe, as breakfast foods are to the grocery store. There is quite a difference. There isn't any question in my mind that certain interests exploit the gold business—I don't say all, I don't say that it is true at all, but it is my belief that the moment we commence to get into special alloys for casting, certain industries commence to exploit the gold business. It can't be otherwise. When you get some alloys that sell for $2.25 or $2.50 a pennyweight and you find there is but 80 cents' worth of metal in them, I would say we are paying for their experiments. I say we must be doing it. We might just as well pay for our own so far as we can. You have to pay for the others anyway.

I want to say that Dr. Weinstein, I believe, has started a great work down there with the Bureau of Standards. Dr. Weinstein has never claimed that he was in that for glory or simply for the benefit of the dentists of this country or for the benefit of humanity. He is going to take off a little on the side for himself, and justly so.

Now I want to say just another word. Do the manufacturers comply with the impression conveyed in their printed claims? Do the manufacturers comply with the claims conveyed in their talk, in their recommendations and advertisements? I assert that many of them do not. There are certain golds that I could name and that I know the analysis of (I know it as well as they know it, it isn't a hard thing to ascertain) that have wonderful claims made for them. From the reading matter we get from the representatives of the manufacturers, if you read the claims and listen to the men demonstrating, you would almost think that if you had a casting machine of a certain make, certain wax and a certain investing material and used their gold, there is nothing to it—just "rip them off" like that, and every one is going to fit and all that sort of thing, which is not true.

The chemical part of this question has been taken up by the other speakers, but not nearly so deeply as I hoped they might go into it. I don't know how much more we might have learned if they had gone into it deeper. It seems to me that there is quite a lot of bugaboo about many of the golds that are on the market.

I have a heading here, "The necessity of a perfect working understanding and complaints of the same between the American Dental Association and the American Dental Trade Association." I think that is just as important as it is that they should give us a good material. If they go half way, we should go the other half. It is just as important, gentlemen, that we do our part as to expect them to do their part. Now fifty-fifty is a good break for any man's money, and farther than that I personally am not willing to go, but I urge you to look at this thing and think it over and let us get a good working understanding between the dentists and the trade association and then try to keep it that way. It is always well to have a check on a man, you know. He gets a little selfish once in a while and we get a little selfish once in a while, and they certainly keep a check on us, an overcheck. Now let us keep a little check on them. I am sure that they would welcome that, and it would be nothing but just if they did do it.

Then I would be happy if a lot of the mystery of making gold castings was taken out of the whole proposition. I don't know that it makes any difference practically whether an inlay is an absolute fit and the absolute size of the cavity for which it is made or not. In fact, I believe that it is better if it doesn't fit absolutely. You have to cement it in, and, therefore, I believe that we can't get any closer by putting all this mystery into the matter. It is exactly what the prosthodontists did, at any rate when they first started out. They had us scared. We couldn't take an impression or do anything, and there was so much mystery about making a set of teeth that a lot of us stopped making them entirely. They scared us to death. They are getting over that. After all, it is common sense, and let us use common sense in all of this business.

If we would not pay so much attention to a certain casting machine, a certain gold, a certain investment and a certain wax, and more to technic, we would get along better. There are many that are better than others, but it is not hard to ascertain those that are among the best at least. If we would take these things as we get them (it is what you have to do anyway) and then pay more attention to our technic, and follow it even as the manufacturers direct in their printed instructions, we would improve our results beyond expectations.

I have been connected with a study club for four years, and I know some of these

things about which I am speaking. I know that if you take almost any gold that is recommended for a certain thing and use it with discretion and care and use your head about it, you will get fairly good results.

As I say, there are golds that for stress and compressibility and retention of shape vary greatly. If we want a casting gold for ordinary single restoration, what do we want better than a good 22 carat gold? I know of nothing better. We might as well pay $1.10 a pennyweight as to pay $1.60. It is practically the same thing, practically as good. But what I am getting at is this: If we pay attention to our materials and particularly to our technic, we will get much farther than if we pay too much attention to materials and too little to technic.

Now, then, there have been many questions asked about the men that are doing this research work. Is it possible for research work to be done by a person or persons who are financed by commercial interests? I mean now dental research work. I think it is. In the first place, they have the best research workers along that line, probably, outside the dental profession. I think it is very possible, but you have got to watch your horses. That is my opinion. I don't say that it isn't being done. I believe that Mr. Weinstein is perfectly honest in his endeavors and I have no doubt that these manufacturers are, too, but you know that the dog goes to the man who feeds him. A man can't go into research work and go into it for fun.

I know one man who makes whole wheat biscuits who has said he is doing it because he wants people to get better bread. He is a millionaire many times over, and he is losing money on his proposition. Well, if he is losing money, he will not continue the business very long, because that is not human nature. These men cannot do this work unless they see a profit in it in some way or another. They have to get something out of this, and we have to pay for it.

The Bureau of Standards has to work on a budget, and that budget comes from the Department of Commerce of the United States. If any industry wants a budget increased for a certain purpose, they must create demands enough for that research work to make the powers from which the Department of Commerce gets their budget increase the budget of the Bureau of Standards sufficiently to do that work or else do it themselves, finance it themselves. That is what Mr. Weinstein has done. He has an investment there, and he has a constant demand on his money all the time in that work. Of course, he is getting something out of it. He is getting a fine training out of it, which is an asset to him, a big asset. Then I have no doubt that he gets other perquisites which it is not necessary for me to speak of. I just want to leave this thought with you, that if we want something done and have it done, we must pay for it and we must pay for it ourselves.

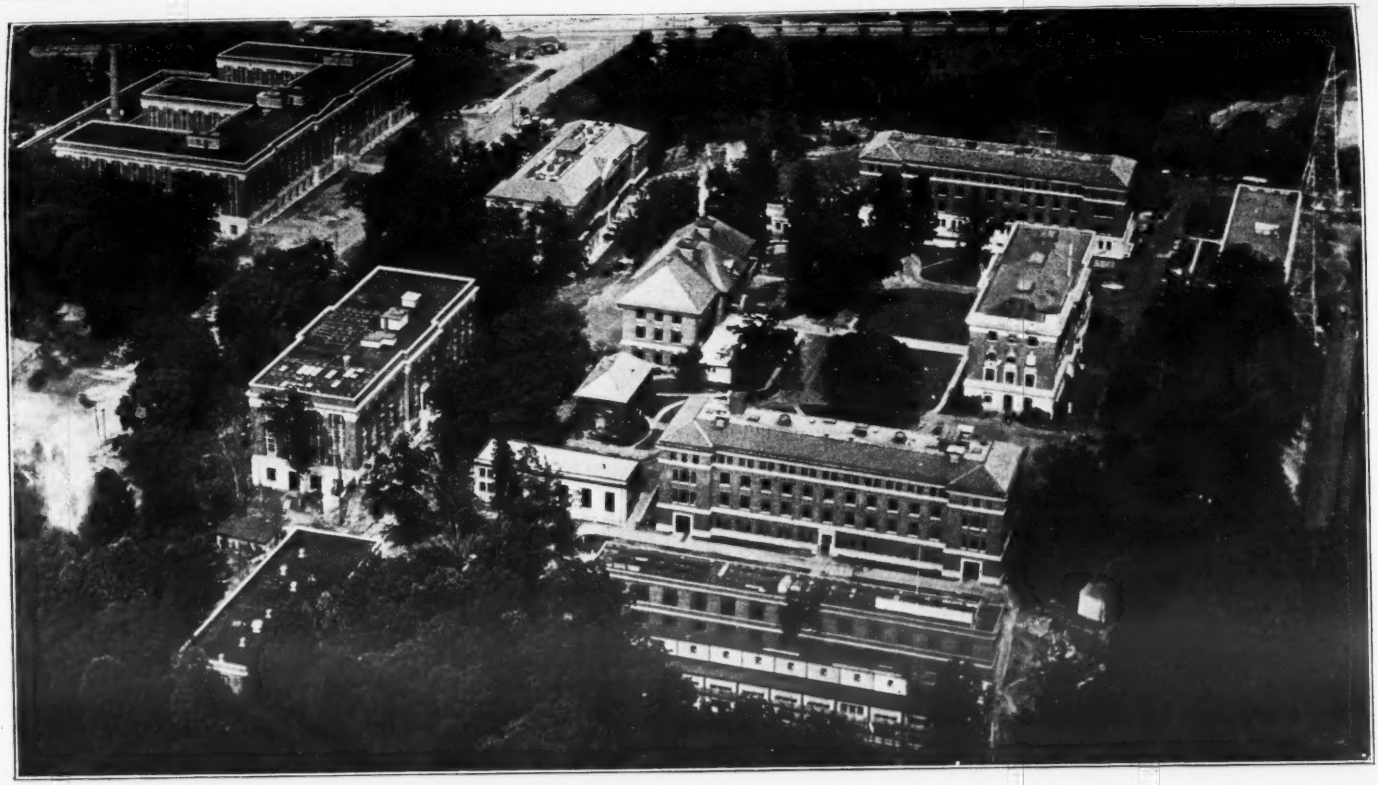
I hope that a working arrangement can be made, either jointly between the Bureau of Standards and the American Dental Association, or between the Bureau of Standards, the American Dental Trade Association and the American Dental Association. I hope that that can be worked out, because from what I know of the work, I am assured that you will be well repaid for the time and money expended. The work can be done in universities, but there are but few universities that are equipped for doing a small work like this. It can be done, but as nearly as I have been able to ascertain, they would have to get new equipment, and I think it can better be done where it has been started.

Dr. Souder (closing): It would be improper for me to ask for the opinions of these gentlemen and then, in any way, disagree with them. I shall carry the compliment which you have made to this work to the associates in the Bureau and tell them their work was very much appreciated.

The question in regard to the Bureau's not going after the American Dental Association or the American Dental Trade Association or anyone else to get this job can be answered briefly. We do not have to look for work, we could close our shop, close our doors now and have enough to keep us going for ten years on problems that it is insistently demanded we investigate at once. This work was taken up only because people kept insisting that we should do it and asked that we begin at once. The Bureau of Standards does not have to look for something to do. We are able to do only a few of the things that are demanded of us.

I apologize for not having a completed paper myself to present to you. No doubt you noticed there were some blanks in parts of the paper. I tried to get those analyses by wire but they are not completed, so I didn't have a complete paper to look over. A large part of the discussion concerned the relations of the American Dental Association and the American Dental Trade Association and it isn't proper for me to discuss those.

The only commission that I have is to get accurate results and stand by the results. The outside relations of the Bureau are handled by the director. I cannot, therefore, advise this Association what I think we can do or what they should do or what someone else should do.



Scientific and technical laboratories of the Bureau of Standards. Laboratories in six of the larger buildings are contributing services to the dental research work now in progress.

PHYSICAL PROPERTIES OF DENTAL MATERIALS II*

(WROUGHT GOLD ALLOYS)

By R. L. COLEMAN, Jr.,† Washington, D. C.

IN 1920, the Bureau of Standards completed research work on the physical properties of dental amalgams. This work, which was done at the request of the War Department, was reported as Section I under the general title "Physical Properties of Dental Materials."[1]

Numerous requests were received by the Bureau, asking a continuation and extension of the research to include the gold alloys and materials incident to their manipulation. The results of such research should enable the dental profession to judge the relative merits and adaptabilities of available materials for specific purposes. The Bureau's finances would not permit it to assume full responsibility for such an elaborate program as appeared necessary. A number of institutions expressed their interest in the research and their desire to see it continued but were unable to assist financially in the program. In November, 1921, after the Bureau had practically decided to drop the plans for the work, the Weinstein Research Laboratories of New York City proposed the following plan:

(*a*) To assume the salary and expenses of a research associate, this associate to be named by the Bureau.

(*b*) To supply all special dental devices and materials necessary for carrying on the research.

The proposal suggested that the Bureau should be responsible for supervision of the work and should make publication of the results in such manner as seemed advisable. This proposal was accepted.

The research was started, with one research associate, in January, 1922. An additional associate and an assistant were secured in 1924. The following data are issued as a partial report of the work completed to date. An outline of the work in progress has been published.[2] Results on other sections of the outline will be presented as soon as tests are completed and data assembled.

The following report on wrought gold alloys and their manipulation should serve a number of purposes. It should supply methods for accurate testing, suggest improvements in manipulation and, in some instances, enable manufacturers to improve their product. While the Bureau has not made a thorough search for all alloys on the market, it does feel that the list includes practically all those for which special merit

*The cooperative research by the Bureau of Standards and the Weinstein Research Laboratories reported in this paper was planned jointly by Louis J. Weinstein, director of the Weinstein Research Laboratories, and Wilmer Souder, physicist, of the Bureau of Standards, who is actively in charge of this work. Their continued aid throughout has been essential to its success. Dr. Weinstein, by reason of his pioneer work and long experience in this field, has been able to contribute valuable aid on the dental problems involved. Dr. Souder directed the scientific phases of the research. Acknowledgment is also made of their assistance in interpreting the results and preparing the material for publication.

*Printed by permission of the Director, Bureau of Standards.

†Research Associate, Bureau of Standards.

1. Souder, W. H., and Peters, C. G.: Bureau of Standards Technologic Paper No. 157, 1920; Dent. Cosmos, 62: 305 (March) 1920.

2. Dental Research, J.A.D.A., 11: 249 (March) 1924.

TABLE 1.—CHEMICAL COMPOSITION OF ALLOYS EXAMINED*

Alloy**	Silver	Gold	Platinum	Palladium	Copper	Zinc	Nickel	Iridium
A	5.1	64.5	17.6	2.1	10.4	0.8	....	....
B†	36.4	41.7	0.1	8.3	9.4	0.3	....	....
C	7.7	59.3	18.3	1.6	13.0	....	....	0.2
D	15.2	62.6	10.4	0.2	11.8	....	....	....
E	15.0	59.5	15.2	....	8.8	....	1.3	....
F	15.4	60.9	16.0	0.2	6.7	0.3	....	0.5
G	0.2	66.2	13.3	19.4	0.2	0.1	....	0.5
H	9.9	61.9	16.0	....	12.1	0.1	....	....
I‡	11.0	60.0	13.1	5.9	8.9	0.72	....	0.2
J	17.7	62.9	12.3	....	6.7	0.1	0.08	....
K	5.0	63.9	13.5	10.2	7.1	0.2	....	0.15
L	....	75.6	7.0	16.1	....	0.07	....	1.2
M¶	9.3	62.3	22.8	0.5	4.5	0.1	0.02	0.4
N	7.3	81.2	7.0	....	4.3	0.1	....	....
O	0.04	89.8	0.08	....	10.0	....	....	....
P	....	67.3	1.0	31.8	....	....	....	....
Q	0.01	89.8	10.0	....	0.07	0.02	....	....
R	0.1	90.6	9.3	....	....	0.02	0.01	....

*Letters indicate firm, grades or trade names. Values are percentages. Dashes indicate not present.

**Tin 0.16 per cent.

†Manganese 3.8 per cent; magnesium 0.1 per cent.

¶Iron 0.2 per cent

‡Tin 0.14 per cent.

is claimed, and a number of those for which no special claims are made. For various reasons, it does not appear advisable at this time to identify alloys by trade names. Identification of materials may be made through correspondence with manufacturers, who will recognize their product by the chemical analysis.

This report contains data on chemical composition, microstructure, melting temperatures, heat treatment, elastic properties and resistance to constantly repeated stresses. Photographs of equipment are included to give more accurate ideas of the arrangement and practical details of tests. In a number of instances, it will be found that the regular testing methods have been modified or adapted to meet the difficulties encountered in testing materials of the dimensions of wire, bands, etc., used by dentists.

No attempt will be made to elaborate on the usual routine methods and requirements for accurate testing. Reference to any standard text of the testing laboratory or engineering school will give these details, should they be thought necessary.

CHEMICAL COMPOSITION[3]

This subject requires little comment at this time. The compositions are given in Table I. The corresponding alloys will be discussed in terms of physical properties as the various physical properties are reached. The specimens were purchased in the open market, but from various sources and at different times. All materials were received in original packages.

All analyses were made in duplicate. The values reported are, in all cases, average values. In most instances, the agreement between duplicate determinations of the major constituents was better than 0.1 per cent (calculated on the sample), with a proportional precision for minor constituents.

The methods of analysis used were selected from methods used by the Bu-

3. Analyses were made by W. H. Swanger, research associate. A portion of the work was done by Mr. Swanger while he was an associate chemist at the Bureau of Standards.

reau's laboratories for other kinds of alloys. They were modified and adapted to suit dental gold alloys. Some details of the procedure required special development. In such cases, methods were always verified by application to mixtures of metals of known composition. A paper describing the methods used will probably appear at a later date.

The chemical analyses serve as a partial definition or identification of the materials tested. A study of compositions and the corresponding physical properties will indicate the importance of care in selecting and maintaining accurate proportions in an alloy. Segregation would be expected to produce serious irregularities or nonuniformity of physical properties. Micrographs are perhaps sufficient for verifying uniformity of mixes.

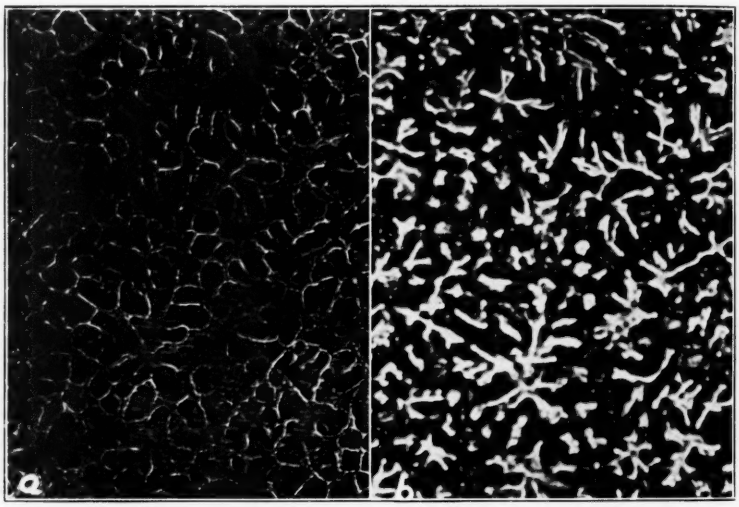


Fig. 1.—Deceptive micrographs of cast orthodontic alloy. *a* and *b* are identical except for change in focus; ×100.

MICROSTRUCTURE

In view of the questionable manner in which this subject has been treated in some of the recent dental literature, it is deemed advisable to preface this section with a brief statement of some of the practical applications and limitations of the study of microstructure as applied to the complex gold alloys. This should serve to obviate the possibility of misinterpretation of the micrographic data presented in this paper.

The suitability of an alloy for any purpose whatever, not alone its application in dentistry, should be judged principally by its mechanical properties. The study of chemical composition, microstructure and other characteristics are of value, but the final criterion must be the mechanical properties, or the behavior of the material under service conditions.

In undertaking the study of the microstructures of these alloys it was hoped to attain the following objects:

1. To supplement chemical analyses as an identification of the materials tested. It is well known that the properties of an alloy are affected by mechan-

ical and heat treatments. Thus, the mechanical properties of a cast rod would not be expected to be the same as those of a wrought rod of identical composition. Nor would the properties of the wrought rod be identical with those of the same rod after being subjected to certain heat treatments. The micrograph should help to define the or absence of the conditions mentioned above, it does not determine the effects of these conditions on the mechanical properties of these complex alloys. This can be done only by determining the mechanical properties themselves.

In obtaining micrographs truly representative of the specimens under test, the preparation of the alloy surface, the

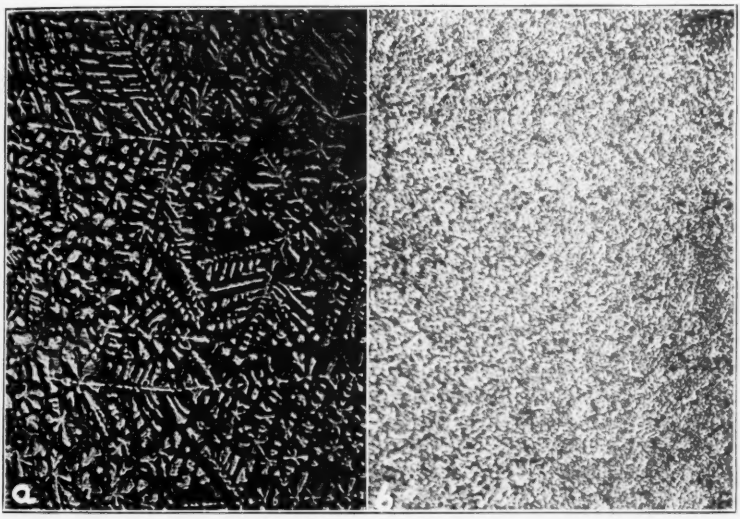


Fig. 2.—Microstructure of alloy A. *a*, cast and slowly cooled; ×50. The beautiful dendritic structure may be observed. *b*, cross sectional structure of an 0.035 wire of alloy A, quenched from 700 C. reheated and cooled slowly from 450 C; ×500.

condition of the alloy with respect to these factors.

2. To reveal microscopic defects, if present, due to casting or mechanical working.

3. To determine the homogeneity of the alloys and the presence of certain impurities.

4. To obtain some information concerning the constitution of the alloys that might help explain how and why their properties may be changed by heat treatment.

It should be borne in mind that while the microscope may reveal the presence etching, the method of illuminating, the focusing and various other factors are of great importance. Accidental or intentional errors in any one of the series are sure to vitiate the result. Figures 1*a* and *b* are included to emphasize this fact. They are from the identical surface and position. The only change is in focus. A close inspection will verify the identity of position and magnification of the two micrographs.

From the foregoing it is evident that the value of a study of microstructure is very limited unless this study is correlated with that of the other important

characteristics of the material and that micrographs presented without sufficient data would be meaningless.

The following micrographs are presented with the foregoing conditions fully in mind. Complete and exhaustive interpretations of all constituents and modifications are not attempted. Further developments in the study of these precious metal alloys may enable us to offer additional comments at a later date.

necessary to improve the physical properties,[5] a second micrograph was made. The etching was done with aquaregia.

Figure 2*a* shows the cast structure of alloy A when slowly cooled. The beautiful dendritic structure is characteristic of solid solutions. This structure does not preclude the presence of intermetallic compounds, which may be present but not shown by the microscope.

Figure 2*b* shows the cross-section

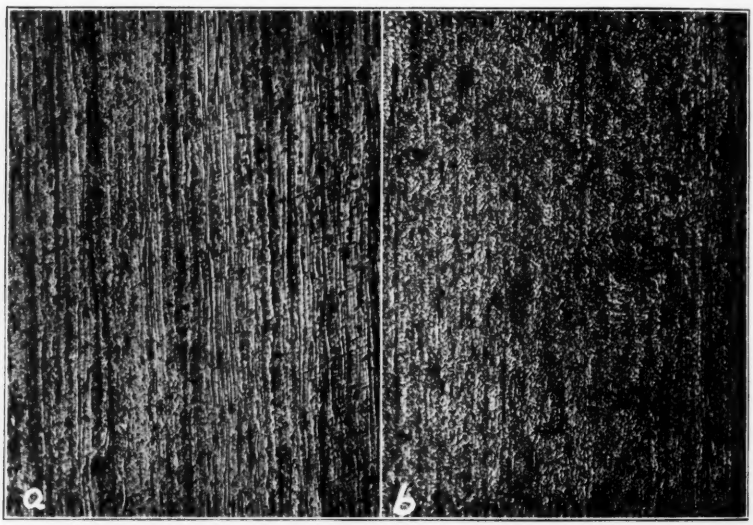


Fig. 3.—Microstructure of wire from alloy A; ×500; longitudinal section. The dendrites of the solid solution of Figure 2*a* have been elongated and ruptured in the drawing process and now appear as light portions elongated in the direction of drawing. *a*, quenched from 700 C. *b*, quenched from 700 C.; reheated to 450 C. and cooled slowly.

There appeared to be some lack of uniformity of materials when received, perhaps due to different amounts of mechanical working at the factory. Since it is usually advantageous to work the alloy soft and heat treat the finished appliance later, we quenched in water all materials from 700 C. (1292 F.)[4] and made micrographs from the quenched alloy. After heat treatment, such as is

structure of a wire of alloy A 0.035 inch in diameter, and Figures 3 and 4 show longitudinal sections of the same wire. The parallel lighter grain structure shown in Figure 3*a* is the dendrite elongated and distorted in the drawing process. Such structures may easily be mistaken for segregations. While it may be possible to call these lines segregations in a very special sense, they are not

4. Temperatures were recorded in centigrade values and are good to 5 C.

5. Compare sections on heat treatment and mechanical properties.

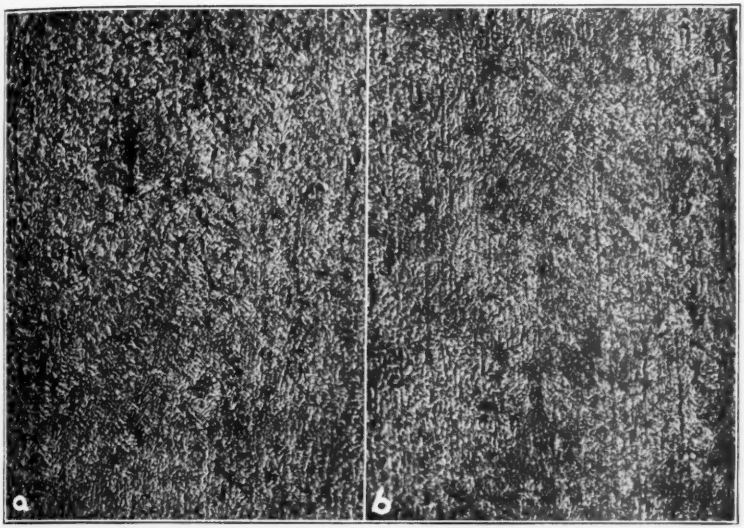


Fig. 4.—Microstructure of wire from alloy A; longitudinal section; ×500. *a*, quenched from 700 C.; reheated to 450 C., and cooled slowly; *b*, quenched from 700 C.; reheated to 450 C., and cooled slowly; again quenched from 700 C. Structures as seen by the microscope are quite similar but physical properties are very different.

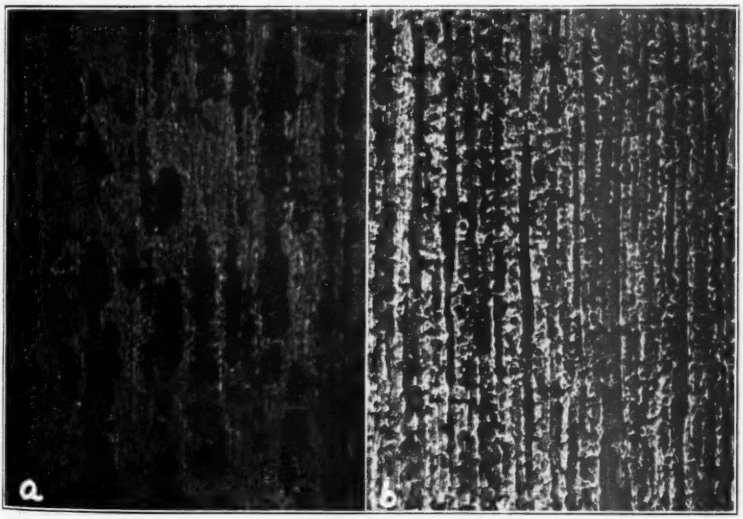


Fig. 5.—Microstructure of wire from alloy B; constants the same as in Figure 4; *a*, quenched from 700 C.; *b*, quenched from 700 C.; reheated to 700 C. and cooled in air.

segregations in the sense of defects due to melting, casting or working but are real characteristic structures for this alloy. This specimen was heated to 700 C. (1292 F.) and quenched. The specimen shown in Figure 3*b* was given the same treatment as that in Figure 3*a*, and in addition was tempered by reheating to 450 C. (842 F.) and allowing the alloy to cool slowly. The severely worked structure has been changed to the more nearly homogeneous structure of an annealed alloy. This structure appears to be permanent, as reheating to 450 C. and cooling slowly (Fig. 4*a*), or quenching from 700 C. (Fig. 4 *b*) did not modify appreciably the microstructure, although, as we shall find later, such treatment does change the physical properties.

Figure 5 shows the structures of alloy B. Figure 5*a* shows the structure of the alloy quenched from 700 C. and Figure 5*b* that of the alloy quenched, reheated to 700 C. and then air cooled. This corresponds to the recommendations of the manufacturer so far as we are able to interpret them.

The heat treatments for the remaining sets of micrographs, Figures 6-11, was quenching from 700 C., as shown in the photographs *(a)*, and later reheating to 450 C. and cooling slowly, as shown in the photographs (*b*). All are of a magnification of 500.

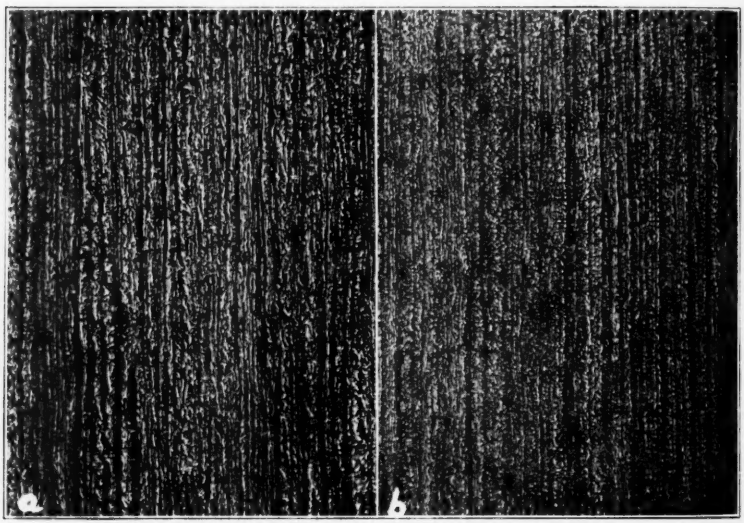


Fig. 6.—Micrograph of wire from alloy C; constants and heat treatment the same as in Figure 3.

The quenched and tempered structures of Figure 7 are very similar and do not show the worked structure. It is concluded that the heat treatment incident to quenching from 700 C. is sufficient to change the worked structure of this alloy, or that this wire was heat treated before leaving the factory. This pair of micrographs is not unlike those of Figure 4.

It should be noted that there is little difference in the structures of alloy G whether quenched or tempered (Figs. 10*a* and 10*b*).

In many cases, the quenched specimens still retain some evidences of ex-

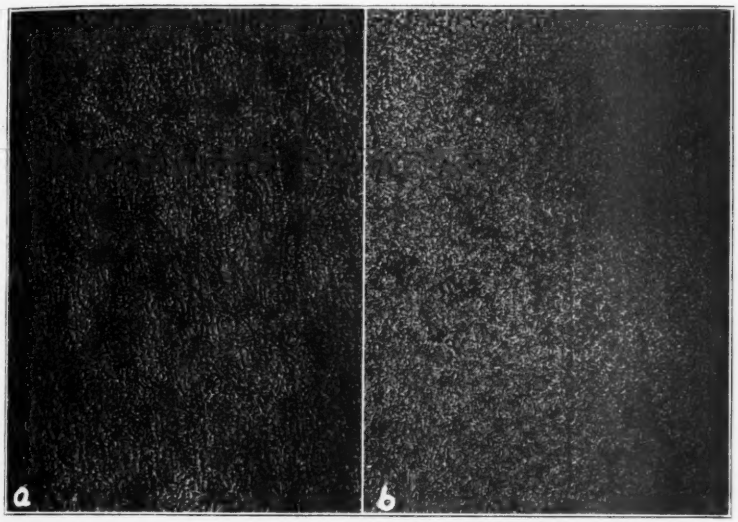


Fig. 7.—Micrograph of wire from alloy D; constants and heat treatment the same as in Figure 3. The worked structure is not prominent.

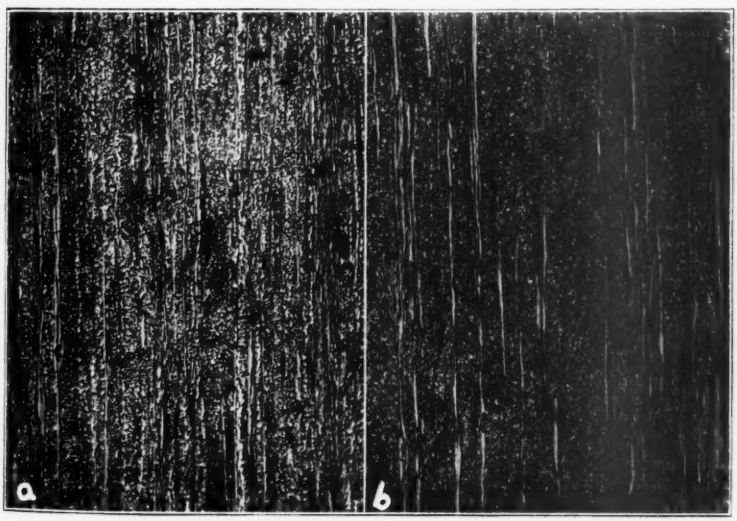


Fig. 8.—Micrograph of wire from alloy E; constants and heat treatment the same as in Figure 3.

treme working in drawing or swaging. To some extent, this structure is modified by the later tempering or heat treatment. The prominent lines of the worked alloy seem to be partially released and refined into a more nearly homogeneous structure. It is not possible to comment on the original crystal structures of all these alloys, as this has been wiped out by the working processes tures, and for this reason further comments will be reserved for the later sections, dealing with mechanical properties.

FUSION TEMPERATURES

Complex alloys seldom have a definite melting point, but usually have a melting range, as illustrated in Figure 12. Complete cooling curves of this type were taken for a number of the

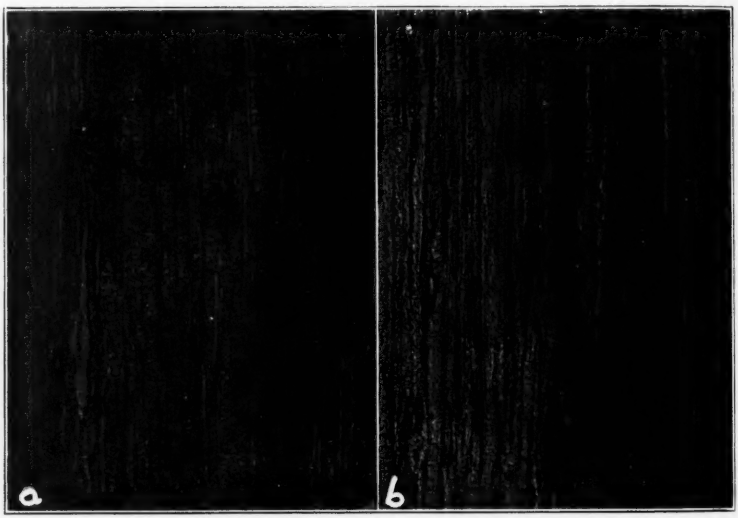


Fig. 9.—Micrograph of wire from alloy F; constants and heat treatment the same as in Figure 3.

incidental to wire formation, but they would perhaps bear close resemblance to Figure 2*a* if handled in the same manner. In some instances, there are indications of incipient new grain or crystal formation. This is more noticeable in Figures 4*a*, 7*b* and 11*b*. It was noted that tempered specimens were more resistant to etching than the corresponding quenched alloys. Evidences of serious defects due to casting or working, oxid inclusions or segregations are absent. In a previous paragraph, it was stated that mechanical properties were of greater importance than microstruc-

alloys, but it was felt that sufficient data could be secured by determining a point within the melting range by means of the "wire" method.[6]

A brief description of this method as employed in these tests follows. A short piece of the alloy (from 3 to 4 mm. long), the fusion point of which was desired, was welded between the wires of a platinum and platinum-rhodium thermocouple to form the hot junction. The thermocouple was connected to a

6. A detailed description of this method is given in Bureau of Standards Technologic Paper No. 170, 1921.

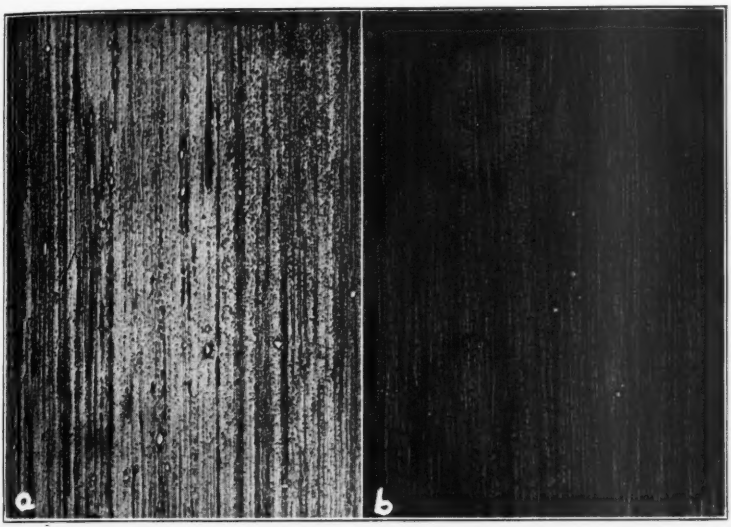


Fig. 10.—Micrograph of wire from alloy G; constants and heat treatment the same as in Figure 3. This wire could not be hardened by heat treatment.

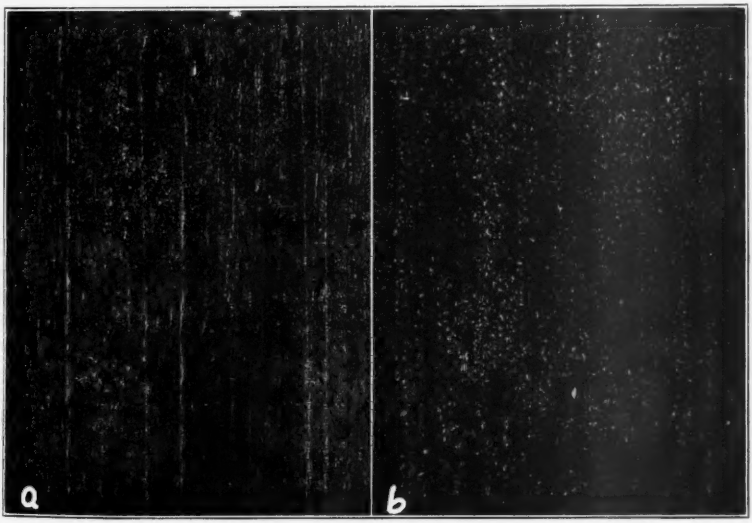


Fig. 11.—Micrograph of wire from alloy H; constants and heat treatment the same as in Figure 3. This alloy will harden appreciably when air cooled from 700 C.

potentiometer; the hot junction inserted in an electric furnace the temperature of which was somewhat below the fusion point of the alloy under test, and the temperature raised at a uniform rate not exceeding 5 C. a minute. The temperature was indicated by the potentiometer. Care was taken to prevent a

Elaborate cooling curves were taken on a few alloys, and when it was found that these gave no more certain indication of the temperature at which failure could be expected, and were perhaps not so accurate, the thermocouple or "wire" method was selected. Repeated determinations of the fusion temperatures

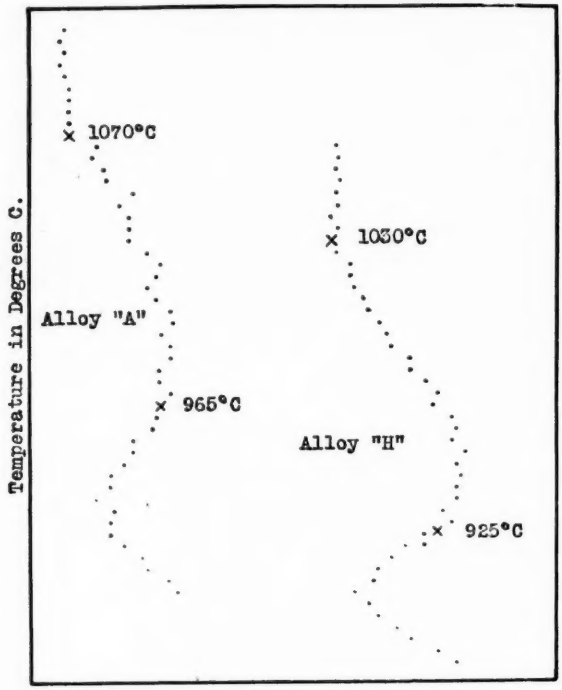


Fig. 12.—Cooling curve for alloys A and H. The time required for the alloy to cool equal temperature intervals is plotted against temperature. This is known as the inverse rate method and locates the freezing range. The temperature at which the molten alloy begins to freeze is indicated by a decrease in the rate of cooling: 1070 C for alloy A and 1030 C for alloy H. Solidification of the alloy is complete when the rate of cooling shows a sudden increase; 965 C for alloy A and 925 C for alloy H.

temperature gradient across the sample that might cause serious error in the indicated temperature. The fusion of the sample, causing a break in the connection between the wires of the thermocouple, was indicated by the potentiometer registering an open circuit.

showed satisfactory agreement. Table 2 gives these fusion temperatures.[7]

No comments are offered as to the most appropriate working temperature

7. H. M. Schmitt and W. F. Roeser of the Bureau's Heat Measurement Laboratory assisted in these determinations.

TABLE 2.—FUSION TEMPERATURES OF ALLOYS*

Wire			Band or Plate		
Alloy	Temperature		Alloy	Temperature	
A	990 C.	1815 F.	J	985 C.	1805 F.
B	895	1645	K	1110	2030
C	1010	1850	L	1325	2415
D	930	1705	M	1065	1950
E	955	1750	N	1010	1850
F	1005	1840	O	935	1715
G	1375	2505	P	1410	2570
H	965	1770	Q	1095	2005
I	1020	1870	R	1100	2010

*Observations are to nearest 5 degrees.

for such alloys. Certainly soldering or heat treating should not be attempted at this fusion point. The nearness to which this point may be approached with safety will depend on the skill of the operator, the control of the furnace or flame, the quality of the solder and other factors. All operators know that soldering operations must be carried out with a solder of correspondingly lower fusion point for each succeeding attachment. The difficulties in securing satisfactory solders of suitable melting points must not be ignored. Data on solders will have to be omitted from this report and reserved for later publication.

The alloys listed in Table 3 are included for reference information, to show the effects on the melting point of gold of the alloying elements sometimes used for changing the melting point, the color, the elastic or other physical properties or the cost. In this group, only the pure elements have exact melting points. The range indicates the temperature interval in which part of the alloy is solid and part liquid. The usual effect of lowering the freezing point of the higher melting element and changing it to a freezing range having an upper limit lower than the freezing point of one or both elements is evident.

HEAT TREATMENT

Some data have been published on the subject of heat treatment of dental alloys, but it was found impossible to coordinate the findings of the different observers. The devices and methods for heat treatment recommended by most lecturers and clinicians are so general in their nature and lack so much in detail that it was decided to make an independent investigation on this subject.

The method of approach may be of interest to those wishing to follow or repeat the tests. There were evidences

TABLE 3.—MELTING POINTS AND RANGES OF A FEW ELEMENTS USED IN DENTISTRY AND SOME OF THEIR BINARY ALLOYS

Element or Alloy	Melting Point or Range	
	Centigrade	Fahrenheit
Gold	1063	1945
Platinum	1755	3191
Palladium	1549	2820
Nickel	1152	2106
Copper	1083	1981
Silver	960	1760
Zinc	419	786
90% Gold 10% Zinc	679— 696	1254—1285
90% Gold 10% Copper	926— 940	1699—1724
90% Gold 10% Nickel	935— 966	1715—1771
90% Gold 10% Silver	1046—1052	1915—1926
90% Gold 10% Platinum	1062—1191	1944—2176
90% Gold 10% Palladium	1270—1287	2318—2349

of differences of elastic properties between wire and bands as purchased and the same alloys quenched from 600, 700 or 800 C. A number of these differed materially from the alloys slowly cooled from these temperatures.

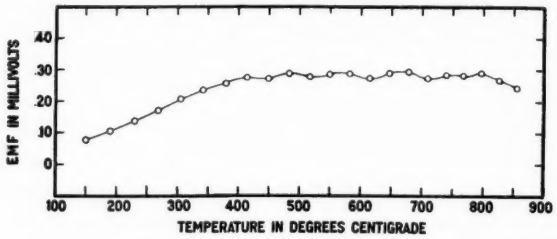


Fig. 13.—*EMF*: Temperature ratio for quenched vs. tempered alloy. Differences between the quenched and tempered alloys, of the same chemical composition, are indicated by a difference in thermal electromotive force. The tempering temperature is indicated by the *EMF* value becoming constant; in this case, about 450 C.

The first problem was to locate the proper temperature and time required to produce these changes. Attempts to locate these constants by changes in cooling curves, or thermal expansivity induced by different heat treatments, were not successful. The next most promising approach appeared to be by changes in thermal electromotive force. By making thermocouples of drawn and quenched, drawn and slowly cooled, and quenched and slowly cooled wires, then observing the *emf* values for increasing temperatures, it was found that changes in electromotive properties were taking place within certain temperature ranges. More careful tests with wires prepared in the manner indicated by this first approximate finding narrowed the range of temperature and time.

Figure 13 represents a typical curve obtained by this method. The values plotted in this figure were obtained from a thermocouple made up of two alloy A wires, one of which had previously been quenched from 700 C. and the other quenched from 700 C., reheated and then slowly cooled. The couple was placed in a furnace, the temperature raised at a rate of approximately 13 C. per minute, and the *emf* of the alloy A couple corresponding to various temperatures was recorded. It will be noted that the *emf* increases with temperature up to about 425 C. and then remains approximately constant, indicating that a transformation has occurred in one or both wires. This temperature was recognized, therefore, as the most likely temperature for changes in mechanical properties. Similar tests on this and other alloys using thermocouple elements that had been subjected to various heat treatments indicated that the maximum softening and hardening effects could be secured by quenching from 700 to 800 C. and slow cooling from 425 to 500 C., respectively.

TABLE 4.—COMPARATIVE TEMPERATURE GRADIENT ABOVE HOT PLATE AND ENCLOSED SHELF OF OVEN

Distance Above Plate or Shelf	Temperature Above Hot Plate		Above Shelf	
Contact	460 C.	860 F.	640 C.	1184 F.
5 mm.	175	347	550	1022
10 mm.	125	257	515	959
25 mm.	120	248	420	788

By testing the various mechanical properties, it was possible to verify these findings. The fuller explanation and proof of this work will be found under the section "Mechanical Properties," following. It is sufficient at this time to say that of the alloys tested practically all those used as wires showed changes when heat treated, while of those used as bands or plate, only three showed any marked change. Some changed properties to some extent without special furnace treatments, mere cooling in air being sufficient. Other wires required five or ten minutes' treatment at a definite temperature, and a slow rate of cooling, to secure maximum results. As a further proof of the correctness of the temperature range specified, numerous specimens of the various alloys were given treatments at temperatures above and below this range, but without improvement above those listed, and in most instances with decided deterioration in results.

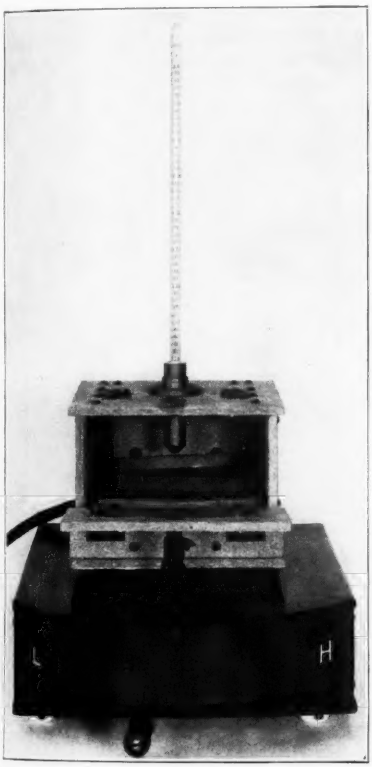


Fig. 14—Electric furnace used for tempering short wires. The work is supported on the silver tray or in a metal box, and the door closed. The thermometer does not give the true temperature of the furnace chiefly because of the conductivity of its support; but when a calibration has been made independently using a thermocouple and potentiometer shown in Figure 15 (instrument B), it is possible to secure a desired temperature by regulating to the previously determined arbitrary values indicated by the thermometer. The temperature gradient for this furnace is given in Table 4.

This at once raises the question of the possibility or efficiency of heat treating in an open flame or on a hot plate as practiced by some demonstrators and dentists. Data taken to determine the temperature gradient from a hot plate will indicate the variations to be expected in an appliance supported on or a few millimeters above the plate. The gradient from an unprotected flame will be found to be much greater. The values are approximate only, since it was found to be impossible to repeat the experiment in all conditions of room temperature, convection of air and other variables. The average results are, however, good to about 10 per cent, which is sufficient to establish the order of variations to be expected. These are assembled in Table 4, together with similar data for an enclosed or box type furnace. Anyone who has made tests of the differences in temperature at various distances above a hot plate will appreciate the difficulties. Qualitative results are quite sufficient to prove the necessity for something better than the hot plate.

The heat treatment was carried through by using furnaces of the type shown in Figures 14 and 15. The long tubular furnace illustrated in Figure 15 insures a close approach to temperature

uniformity. The box type illustrated in Figure 14 showed a gradient of 90 degrees at 640 C. from the shelf or support temperature for a vertical distance of 5 mm., as compared with a gradient of 285 degrees at 460 for a similar distance above the hot plate. Further uniformity may be secured by placing the appliance in a metal box of high conductivity, say of silver or some of the gold alloys, and placing this box in the furnace. This box containing the appliance should have a cover and should be placed in a symmetrical position of the furnace. In practice, such refinements may be uncalled for, but in research they are imperative. The hopelessness of securing satisfactory results from a hot plate is evident from Table 4. The usual height of the finished appliance is such that parts of it are out of the tempering temperature. This may not be remedied by increasing the plate temperature, for, when the proper temperature at 5 mm. above the plate is secured, the plate will have reached an excessive temperature for that part of the appliance in contact with the plate. It is also useless to speculate on the effects in an open flame. While the increased values for life flexure or elastic properties may not appear to be worth the added time or expense necessary to secure them, it must be remembered that diagrams or designs for orthodontic appliances are planned with the idea of securing definite forces throughout the appliance. The effects of spots of increased or decreased elastic properties developed by accidental heat treatment from soldering may seriously

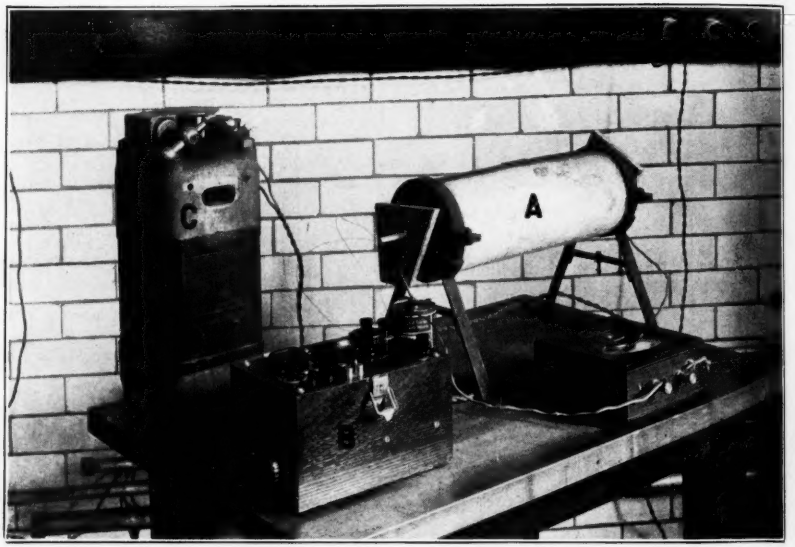


Fig. 15.—Tubular furnace, potentiometer and transformer used for heat treating wires. This set-up was used for heat treating long samples. This tube furnace (instrument A) will produce temperatures up to 1,000 C. The temperature distribution is exceptionally uniform. Temperature is measured with the thermocouple and potentiometer (instrument B) and is controlled by means of the voltage regulator (instrument C). The potentiometer is superior to the usual pyrometer as a temperature measuring instrument. The pyrometer consumes current and is affected by changes in resistance of the couple or leads of the circuit.

modify the direction of the resultant pressure and thus modify the path or direction of movement of the tooth. Cold worked sections not subsequently reheated present the same difficulties. The obvious method for preventing these defects is reheating and quenching for uniform softness and tempering for uniform and increased elastic properties.

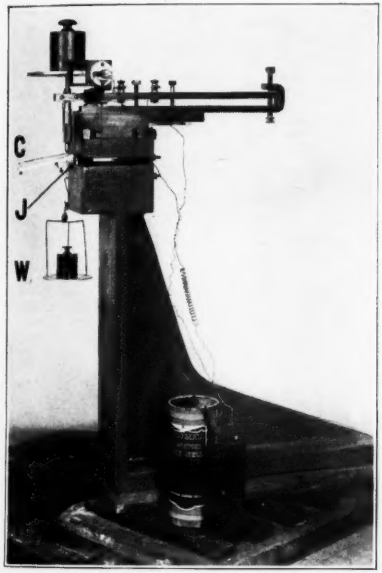


Fig. 16.—Francke machine for static flexure tests. This apparatus was designed by W. J. Francke for use in charting certain differences in elastic properties of materials.

MECHANICAL PROPERTIES[8]

As was stated in a previous section, the suitability of an alloy for any purpose whatever should be judged principally by its mechanical properties. For this reason, in the present research, the major part of the work was devoted to the determination of the mechanical properties of the various alloys and the possibility of improving these properties by heat treatment. Most of the conclusions are drawn from the results of these tests.

Tests of this nature are of greatest value only when life-size samples are used and the conditions of test approximate those of actual service. Practically all standard testing equipment is designed for samples much larger than are used in dentistry. Hence, in most cases, it was necessary to use special equipment. A description of the apparatus used and the results of tests follow.

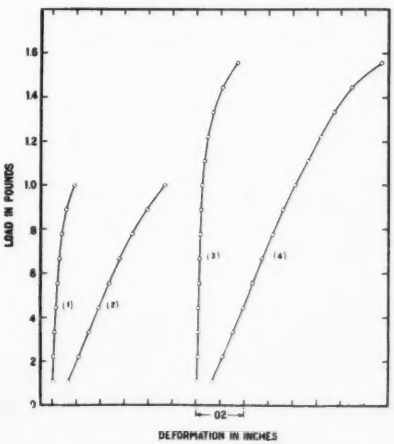


Fig. 17.—Static flexure curves. These curves indicate the deformations produced by the addition of corresponding transverse loads to a 0.035 inch wire of one-half inch effective length. *2* and *4* are actual deformations while the loads are applied. *1* and *3* are permanent set after the loads are removed. *1* and *2* are for alloy A quenched. *3* and *4* are for alloy A quenched and tempered. The deformations are obtained by evaluating the departures to the right from a vertical line passing through the foot of the curves.

The decided improvement by tempering is evident when curves *1* and *2*, quenched, are compared with curves *3* and *4*, tempered.

1. *Static Flexure Test (Francke Machine).*—The instrument used in making these tests was invented by the late

8. The valuable advice and assistance of the Bureau's Laboratory of Engineering Mechanics is acknowledged.

TABLE 5.—EFFECT OF HEAT TREATMENTS ON MECHANICAL PROPERTIES OF ALLOY A

Heat Treatment	Deflection for 0.005 In. Set Inches	Load for 0.005 In. Set Pounds	Load for 0.010 In. Set Pounds
Hard Drawn	0.0585	1.32	1.54
325 C. 10 min. Quenched twice	0.0730	1.65	1.87
450 C. 10 min. Quenched	0.0785	1.76	.....
600 C. 2 min. Quenched	0.0685	1.54	1.65
700 C. 2 min. Quenched	0.0420	0.88	0.99
800 C. 2 min. Quenched	0.0480	0.88	0.99
700 C. Quenched 325 C. 10 min. Furnace Cooled	0.0560	1.21	1.32
700 C. Quenched 320-410 C. 30 min. Air cooled in pan	0.0510	1.10	1.27
700 C. Quenched 400 C. 5 min. Furnace Cooled	0.0600	1.21	1.38
700 C. Quenched 450 C. 5 min. Furnace Cooled	0.0630	1.49	1.65
700 C. Quenched 450 C. 5 min. Air cooled in pan (Room temp. in 2½ min.)	0.0570	1.27	1.38
700 C. Quenched 500 C. 20 min. Furnace cooled 20 min.	0.0520	1.21	1.38

W. J. Francke of New Brunswick, N. J., and is fully described in a paper by Mr. Franke.[9] The instrument is shown in Figure 16. A brief description follows. One end of the sampler under test is fastened in jaws (*J*), the other carries a contact indicating device (*C*). A pan and weight are added at (*W*). These weights cause a deflection of the specimen, which is measured by the micrometer. If the point of the micrometer and indicating device do not meet at the axis of the specimen, a correction is required for the indicated deflection. After the deflection is measured, the weights are removed and the return of the sample is measured by the micrometer. The difference between the deflection and return value is the set or permanent deformation. By using samples of uniform dimensions and increasing the load by small increments, it is possible to obtain relations between load, deflection and set that furnish an excellent basis of comparison of the different alloys; the effects of different heat treatments and other factors.

In Figure 17, the values for set and deflection for two wires, alloy A quenched and alloy A tempered, are plotted against the corresponding loads. This test was used as a check on the *emf* method mentioned in a previous section in establishing the proper heat treat-

9. Proc. American Soc. for Testing Materials, 20: 372, 1920.

ments for the various alloys. The values obtained for some of the heat treatments given a single alloy (alloy A) are given in Table 5, and a summary of the values for all the wires tested is presented in Table 6. The samples used in these tests were round wires, 0.035 inch in diameter, and the distance from the jaws to the point at which the load was applied was one-half inch. In order to eliminate the variation in the size of wires of different manufacture, all wires were purchased as No. 19 gage (0.036 inch) and drawn through a diamond die 0.035 inch in diameter.

By referring to Table 5, it will be noted that quenching from 600 C. or lower temperatures not only does not soften, but the heat treatment incident to heating to 600 C. actually hardens or increases the rigidity of the hard drawn wire, as is evidenced by the increased load necessary to cause a permanent deformation of 0.005 inch. Quenching from 700 C. or over produced the greatest softening effect. Other tests not included in this table seemed to indicate that quenching from temperatures higher than 800 C. is not desirable because alloys subjected to such treatment would not retemper so readily. These results were verified by similar tests on other alloys, and 700 C. was adopted as the standard quenching temperature.

In the lower part of the table, values are given showing the effect of additional heat treatment after quenching from 700 C. Heating to temperatures below 300 C. and cooling slowly had little if any effect. Slow cooling from temperatures ranging from 325 to 500 C. had a marked hardening effect, the magnitude of the change increasing as the temperature was raised to 450 C., and also as the rate of cooling was decreased. The maximum effect was obtained by cooling from 450 C. to room temperature in about three hours. (This was the slowest rate of cooling employed.) As the temperature was raised above 450 C., no additional improvement was noted, and temperatures above 600 C. seemed to cause a slight deterioration. These values also were verified by similar tests on other alloys, and 450 C. was adopted as the standard tempering temperature. The rate of cooling adopted was from 450 to 250 C. in one-half hour. Tests proved that a slightly faster rate can be employed without serious loss, and in some cases more desirable properties are secured. This point will be taken up again in the section on tensile properties.

In the recent literature, claims are made that acid pickling of alloys of this nature, to remove surface oxidation, is injurious to their mechanical properties. In order to test this effect, alloys A, E and F were subjected to several pickling treatments and then tested in the manner described above. The pickles used were sulphuric acid solutions up to 20 per cent and hydrochloric acid solutions up to 33 per cent. The samples were quenched, tempered and then boiled in these solutions for periods ranging from two to ten minutes. In no case was any deleterious effect detected.

In the heat treatment of the alloys, presented in Table 6, and all those that follow, the quenching was carried out by cooling in water from 700 C., and the tempering by reheating the quenched alloys to 450 C., and cooling at such a rate that the temperature was reduced to 250 C. in one-half hour, unless otherwise stated. Values for deflection and load corresponding to a permanent set of 0.005 inch are given for all wires tested in both the quenched and tempered states. The load necessary to produce a set of 0.010 inch and the difference between this load and the load for a 0.005 inch set are also given. The load required to cause a set of 0.005 inch may be considered as a measure of the stress to which the wire may be subjected without serious injury or without causing it to lose its shape. This is equivalent to the force the wire may be made to exert when used as a spring.

TABLE 6.—RESULTS OF FLEXURE TESTS (FRANCKE)

	Alloy	Deflection for 0.005 In. Set	Load for 0.005 In. Set	Load for 0.010 In. Set	$Load_2$-$Load_1$
		Inches	Pounds	Pounds	Pounds
A	Quenched	0.0400	0.88	.99	0.11
	Tempered	0.0510	1.21	1.43	0.22
B	Quenched	0.0335	0.66	0.77	0.11
	Tempered*	0.0595	1.21	1.54	0.33
C	Quenched	0.0500	0.99	1.21	0.22
	Tempered	0.0600	1.43	1.76	0.33
D	Quenched	0.0455	0.99	1.21	0.22
	Tempered	0.0490	1.10	1.32	0.22
E	Quenched	0.0360	0.77	0.94	0.17
	Tempered	0.0385	0.88	1.10	0.22
F	Quenched	0.0385	0.77	0.99	0.22
	Tempered	0.0510	1.21	1.43	0.22
G	Quenched	0.0380	0.99	1.21	0.22
	Tempered	0.0475	1.16	1.43	0.27
H	Quenched	0.0390	0.88	1.05	0.17
	Tempered*	0.0439	0.99	1.21	0.22
	Tempered	0.0630	1.49	1.82	0.33

*Air cooled from 700 C.

The deflection caused by this load is the distance through which the spring will exert force and the product of these two, force times distance, is a measure of the work the spring will do, or its resiliency. The difference between the load necessary to cause a set of 0.005 inch and that to cause a set of 0.010 inch furnishes a basis for judging the relative manipulative qualities of the wires. If the difference is small, it indicates that, after an initial set (0.005 inch) has been produced, an additional load causes a relatively large deformation, or the wire is easily manipulated. It has also been found that, in most cases if the difference is large, the wire is brittle and will break readily when a large deformation (or sharp bend) is attempted.

It should be borne in mind that the values obtained by this method are relative only. So long as the dimensions of samples and conditions of test are uniform, comparative values may be derived. However, owing to certain characteristics of the instrument which require correction factors for large deflections, when testing samples of small cross-sections, absolute values for excessive deflections could not be obtained by this method. For determining various properties of both wires and flat stock in terms of absolute units, the dead load tensile test was employed.

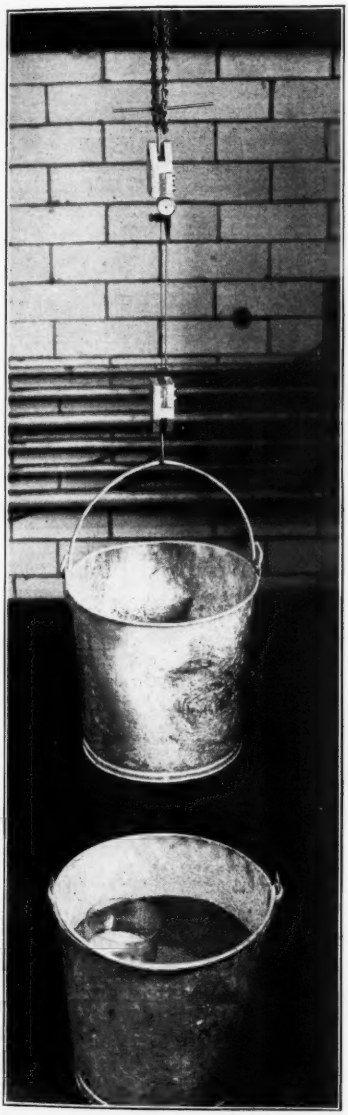


Fig. 18.—Dead load tensile equipment. The extensometer attached indicates strain values used in stress-strain plots. From these plots of stress-strain ratios, elastic properties are secured. Stresses are applied by pouring shot into pail suspended from specimen.

2. *Tensile Tests.*—The apparatus used for this test is shown in Figure 19. The sample, either a round wire of a flat strip or band, is held in the jaws and the jaws mounted on knife edges. Load is applied by pouring lead shot in definite quantities into the pail. Deformations are measured by means of the extensometer, which consists of a mechanical indicator and an extension rod to cover the necessary gage length. The extensometer shown in the figure was used for wires. A modification of this employing two indicators, one on each flat side, was used for strips. Loads and the corresponding deformations were recorded in the usual manner until a stress well above the proportional limit was reached. The extensometer was then removed and loads applied until the sample failed. All wires were purchased as No. 19 gage (0.036 inch diameter, and drawn through the 0.035 inch diamond die. The wires were then measured and found to be uniformly 0.035 inch in diameter within the limit of accuracy of the micrometer. The strips were purchased as 0.23 inch wide and 0.006 inch thick. The variations in dimensions were compensated for by measuring each strip at several points. All samples, except when otherwise stated, were 12 inches long, and the gage length over which deformation was measured was 8 inches. The load increments were known to better than 0.1 per cent, and the readings of the extensometer were accurate to 0.0002 inch or better.

In Figure 19, deformation in inches per inch is plotted against load or stress in pounds per square inch for four wires, *A-quenched, A-tempered, D-quenched* and *D-tempered,* and two bands *L* and *R*. A summary of values obtained for all wires and strips tested is given in Tables 7 and 8. The properties determined by this test and given in these tables are defined as follows:

Proportional limit: The stress at which the deformation as determined by the extensometer ceases to be propor-

tional to the load. In the case of the alloys tested, it was found that deformation was not strictly proportional to stress even for very low stresses. In these tests, the load increments were uniform and the proportional limit was taken as that stress at which the next increase in load caused an increase in deformation exceeding the previous mean increment by 10 per cent. This value may be taken as the maximum

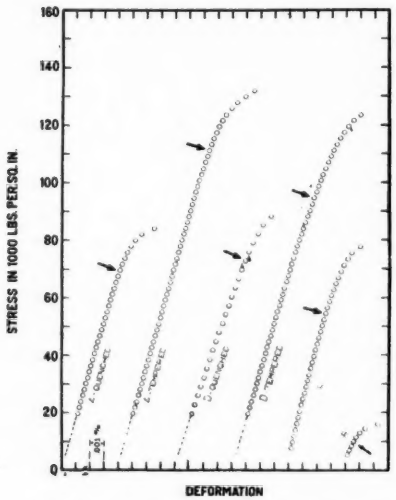


Fig. 19.—Stress-strain curves. These are typical curves for tensile tests and require little explanation. The proportional limit is indicated by the arrow. The improved qualities for alloys A and D when tempered are evident. Alloy L does not temper, and hence has the same curve for quenched or tempered state. Alloy R shows very feeble elastic properties. The curves are plotted only a few points beyond the proportional limit. The ultimate tensile strength values must be secured from the proper tables and not from these curves.

stress to which the sample can be subjected without serious permanent deformation and is of sufficient accuracy for all practical purposes.

Ultimate tensile strength: The stress causing rupture of the sample.

Elongation: Total elongation after rupture in percentage of the original gage length. The elongation indicates the ductility or manipulative qualities of the material.

Modulus of elasticity: Ratio of stress within the proportional limit to the corresponding strain or deformation. It is a measure of stiffness or the force required to produce a given elastic deformation.

Modulus of resiliency: The potential energy stored up in a cubic inch of material at the proportional limit. It depends on the proportional limit and the modulus of elasticity and is a measure of the work the material can do with safety when used as a spring.

By referring to Table 7, it will be noted that tempering caused an increase in strength for all wires tested except alloy G. All alloys were tempered in accordance with the method described except alloy B and one series of alloy H. These were tempered according to the recommendations of their respective manufacturers; namely, by cooling in air from approximately 700 C. The wires developing the highest tensile strengths in the tempered condition were alloys H, C and A, in the order named. Of these, alloy A, with an ultimate strength of 153,000 pounds per square inch showed the highest elongation, 7.5 per cent. This was the highest elongation shown by any tempered wire, with the exception of alloy H, air cooled from 700 C., which developed a much lower ultimate strength.

Values for a series of alloy H wires tempered by the standard method are included for the purpose of illustrating the effect of the rate of cooling. It will be noted that both the proportional limit and the ultimate strength are greatly increased by the slower cooling, while the elongation drops from 10.6 per cent for the quenched and 8.4 per cent for the air cooled, to only 0.5 per cent. The other alloys tested were found to be affected in the same way, though to a lesser degree. From this, it is concluded

TABLE 7.—TENSILE PROPERTIES OF WIRE*

Alloy		Proportional Limit		Ultimate Strength		Elongation in 8 In. per Cent	Modulus of Elasticity Lb. per Sq. In. $\times 10^{-6}$	Modulus of Resiliency in Lb. per Cu. In.
		Lb.	Lb. per Sq. In.	Lb.	Lb. per Sq. In.			
A	Quenched	68	71,000	104	108,000	12.5	17	147
	Tempered	106	110,000	148	153,000	7.5	18	332
B	Quenched	62	64,000	90	94,000	11.0	17	119
	Tempered†	84	87,000	119	124,000	3.6	17	223
C	Quenched	81	84,000	119	124,000	9.6	18	193
	Tempered	128	133,000	168	175,000	4.6	19	473
D‡	Quenched	71	74,000	104	108,000	8.8	14	201
	Tempered	92	96,000	132	138,000	1.0	17	278
E	Quenched	61	63,000	97	102,000	10.2	16	122
	Tempered	73	76,000	118	123,000	6.8	17	172
F	Quenched	66	69,000	98	102,000	9.2	17	138
	Tempered	75	78,000	113	118,000	6.0	16	187
G	Quenched	77	80,000	121	126,000	2.9	20	162
	Tempered	79	82,000	118	123,000	3.2	21	162
H	Quenched	76	79,000	109	113,000	10.6	17	186
	Tempered†	83	86,000	125	130,000	8.4	16	228
	Tempered	116	121,000	169	176,000	0.5	18	402

*All wires of 0.035 inches diameter.

†Air cooled from 700 C.

‡Ten inches total length; 6 inches gage length.

that, for most of these alloys, a balance between the desirable, but more or less opposed properties of high strength and high ductility, can be effected by varying the rate of cooling in the tempering operation. In this manner, the most desirable combination of properties for a given purpose can be secured. A faster rate of cooling than that employed in these tests would increase the elongation and decrease the strength. Slower rates, except in the case of alloy B, would not change the values very much from those reported unless rates so slow as to be impracticable in ordinary practice were employed. The length of time the sample was held at the tempering temperature was found to be of less importance than the rate of cooling.

The foregoing remarks do not apply to alloy G since it is not susceptible to hardening by heat treatment. This may be due in part to the low copper content. It will also be noted that the modulus of elasticity of alloy G is higher than that of any other alloy in this group. A possible explanation of this lies in the fact that this alloy contains an appre-

TABLE 8.—TENSILE PROPERTIES AND HARDNESS OF BAND AND PLATE MATERIAL*

Alloy		Proportional Limit Lb. per Sq. In.	Ultimate Strength Lb. per Sq. In.	Elongation in 8 Inches Per Cent	Modulus of Elasticity Lb. per Sq. In. ×10—⁶	Modulus of Resiliency Lb. per Cu. In.	Brinell Hardness	U. T. S.† / B. H. N.‡
I	Quenched	58,000	98,000	12.1	16	103	155	0.63
	Tempered	116,000	157,000	4.6	18	384	230	0.68
J	Quenched	56,000	90,000	10.1	15	102	145	0.62
	Tempered	89,000	118,000	2.2	16	249	185	0.64
K	Quenched	57,000	94,000	19.2	17	94	140	0.67
	Tempered	69,000	104,000	15.5	18	132	150	0.69
L	Quenched	50,000	88,000	4.6	20	62	145	0.61
	Tempered	54,000	91,000	3.7	21	70	150	0.61
M	Quenched	31,000	86,000	9.9	16	31	140	0.61
	Tempered	44,000	90,000	10.6	15	64	140	0.64
N	Quenched	25,000	59,000	18.8	13	23	85	0.69
	Tempered	29,000	60,000	15.6	14	30	90	0.67
O	Quenched	21,000	55,000	28.9	13	17	90	0.61
	Tempered	21,000	54,000	26.2	13	17	90	0.60
P	Quenched	13,000	48,000	23.9	14	6	70	0.69
	Tempered	13,000	48,000	20.0	17	5	65	0.74
Q	Quenched	11,000	37,000	17.5	12	5	60	0.62
	Tempered	12,000	38,000	19.6	12	6	60	0.63
R	Quenched	9,000	35,000	23.7	10	3	50	0.70
	Tempered	10,000	35,000	20.5	11	4	55	0.64

*All specimens were approximately 0.23 by 0.006 inches.

†Ultimate tensile strength in 1,000 pounds per square inch.

‡Brinell hardness number.

ciable amount of iridium and is low in copper. This may also account for its low elongation.

By referring to Table 8, it will be noted that alloy I is affected by heat treatment to a marked degree. Alloys J and K are affected to a lesser degree. The remaining alloys of this group are not affected appreciably. The modulus of elasticity of alloy L is high, probably owing to its iridium content. In the case of the alloys of very low strength, particularly Q and R, the proportional limit could not be determined with the highest degree of accuracy, owing to the limited range of stresses over

which observations could be made. The values reported are the best that could be obtained with the equipment available, but probably are slightly higher than they should be. This would account for the low values for modulus of elasticity. The importance of these alloys, Q and R, was not considered sufficient to warrant the construction of apparatus for determining these values with greater precision.

The values for modulus of resiliency are useful chiefly for purposes of comparison and indicate decided superiority for certain alloys when used as springs.

3. *Brinell Hardness.*—The instrument[10] used for making these determinations is a modification of the standard Brinell Hardness Tester and was designed especially for testing small samples. The ball is hardened steel 1.6 mm. (1/16 inch) in diameter and a load of 6.4 kg. (14.1 pounds) was used. This combination is equivalent to a 10 mm. ball and 250 kg. load. The samples used for this test were strips approximately 0.23 inch wide by 0.006 inch thick. While samples of these dimensions are too thin for the determination of hardness with the highest degree of accuracy, the values obtained bear a definite relation to the true hardness and are comparable. Tests of several alloys using anvils varying in hardness from hardened steel to bronze indicated that this factor had no appreciable influence on the values obtained. The Brinell hardness numbers of all strips tested, in both the quenched and tempered state, are given in Table 8. Determinations were also made on all strips as purchased, as a matter of record. As these values are thought to be of little importance to the dentist, they are not included in this report. The ratio, ultimate tensile strength in 1,000 pounds per square inch divided by Brinell hardness number is also given in Table 8. From these values, the relation between these two properties, for alloys of this group, excepting only alloy P tempered, may be written as $S=.65H\pm8\%$ where S is tensile strength in 1,000 pounds per square inch and H is Brinell hardness number.

4. *Life Tests (Repeated Stresses).*—To most dentists, this will appear as a new test. It is included to give data on the failure of appliances and attachments. Numerous complaints about failures because of "crystallization" are to be found. While it is now generally admitted that the term crystallization is not proper, at the same time the failures are in no way modified and whether they are called crystallization, segregation or fatigue failures matters little provided we comprehend what is meant. By adopting the term fatigue failure, i.e., failure from repeated stresses, it is hoped to make the situation definitely understood. A number of difficulties were met in planning this test. Special equipment had to be designed. One of the first questions met was: "Shall we use constantly repeated stresses or constantly repeated deflections? Without entering into the question at this time, it may be stated that constantly repeated stresses appear to be the more desirable and cover the situation well. One illustration will make this clear. A spring or clasp appliance can be made to fit a tooth, to slip on or off and fit well in all positions even though made from the thinnest or smallest gage wire or strip, but the operator does not select the smallest for the work; rather, he selects a material of larger size to secure sufficient firmness and stability in position as well as resiliency and resistance to stress incidental to usage. For this and other reasons, the constant stress feature was designed into the apparatus. Another question was met in selecting proper stress values. For relatively large stresses, a failure could be pro-

10. Goodale, S. L., and Banks, R. M.: Development of Brinell Hardness Tests on Thin Sheet Brass. Proc. Am. Soc. for Testing Materials, 19 (Pt. 2): 757, 1919.

duced by, say, from ten to twenty reversals. Manifestly, this number does not duplicate or approach conditions of satisfactory service in the mouth. An appliance failing at the tenth application of stress would be useless. Attempts to secure data covering all ranges of stress and number of reversals could not be justified since the time required for those values representing millions of reversals would require months for each point of the curve. The final decision was to use a stress that would cause failure between 10,000 and 100,000 reversals. The poor materials, inferior by reason of composition or manufacture should fail before those of better quality, and the differences should be relatively large. It is probable that the selection of a different stress value might change, slightly, the relative arrangement or order of failure, but such changes as are necessary to produce an arrangement differing appreciably from that reported cannot be justified from service conditions.

The following description of Figure 20 will give a more definite idea of how these tests are made. The material to be tested is cut into 3-inch lengths and fastened in a horizontal position between one of the pairs of upright holders (three pairs are shown at the top of the photograph). A yoke is placed over the material midway of the holders, and cords fastened to either side of the yoke pass over pulleys and support weights. This arrangement gives a balanced con-

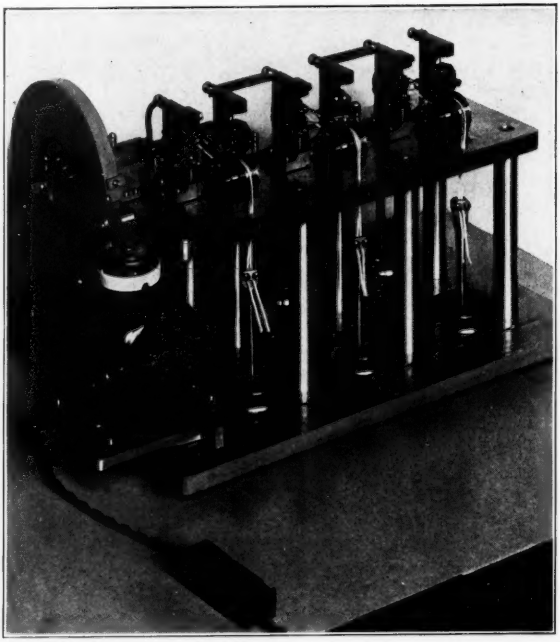


Fig. 20.—Dead load flexure equipment. This equipment was designed to secure data on the repeat stress values for springs, clasps and attachments. The wire is subjected to flexures until it breaks.

TABLE 9.—RESULTS OF FLEXURE LIFE TESTS: NUMBER OF REVERSALS TO CAUSE FAILURE*

Alloy	A	B	C	D	E	F	G	H
Quenched	15,000	4,000	23,500	.....	.....	.....	19,000	41,000
Tempered	75,000	15,000	88,500	23,500	18,000	25,000	24,000	58,000

*Average of several tests given to nearest 500.

dition until one of the weights is lifted, when the remaining weight causes a flexure of the material because of the unbalanced stress relation. Alternate liftings of the two weights are provided by the motor shown at the left. This procedure is continued until a failure occurs. The counter is then read, a new specimen placed in position and the operation continued.

The values for the alloys tested are recorded in Table 9. A number of values were determined for each heat treatment. This serves two purposes: first, some idea of the reliability of the results may be obtained; second, extreme variations for certain alloys indicate lack of uniformity in manufacture. The latter conclusion is valid by reason of the exceptional agreement of a large number of other alloys.

Since local imperfections may cause failure and since materials may vary, it is felt that all results should be grouped and studied from average values rather than to place too great importance on any one value. A further precaution which should not be forgotten is that comparisons should be made on all properties of an alloy and not on any one item, such as chemical composition, or fatigue failure.

With all the foregoing precautions in mind, the values in Table 9 carry definite indications. The useful life of alloy A was increased fivefold by heat treatment. In other words, a clasp of this alloy formed and quenched, then subjected to alternating stresses, may be expected to last only one-fifth as long as a clasp made from the same alloy but given proper heat treatment. Other alloys show varying increases. This may account for some of the experiences involving apparent inferiority of identical alloys. It is known that an appliance often weakens or takes a permanent set and becomes useless before actual breaking occurs. Bending or reshaping may remedy this condition to some extent, but unless the mechanical properties of proportional limit, modulus of elasticity, and ductility or percentage elongation are favorable, the reshaping will be of little permanent value.

Manifestly, the material should be shaped in the quenched condition. A large percentage elongation is essential for successful shaping. Otherwise, the material will be regarded by many as brittle. Once the proper shape is secured, it is essential to temper for the added life value. Three alloys, having low values for the tempered state, were not tested for the quenched state. Values from Tables 7 and 8 indicate that the failures for these are to be anticipated as lower than for the tempered state.

Table 9 shows the life service to be expected from alloys of chemical compositions corresponding to the analyses of Table 1.

The valuable advice and assistance received from a number of the members of the dental profession who so carefully prepared replies to the questionnaire published[11] are gratefully acknowledged.

CONCLUSIONS

It is not considered within the province of this paper to make any arbitrary selection of one alloy as superior to another. The reader must do this for himself. The purpose of this paper is to describe methods of testing and the virtues and values for the physical properties tested. It is believed that all tests outlined in this paper can be repeated

11. J.A.D.A., 11: 249 (March) 1924.

in the dental school or laboratory without excessive expense for equipment, and that students and practitioners may be given fundamental methods that will enable them to select accurately and quickly in the laboratory the best material on the market. Obviously, such methods can eliminate the necessity for the expensive and dangerous method of trying them out on patients.

SUMMARY

1. In the chemical analyses of a number of commercial alloys used in orthodontia and prosthodontia, the number of elements present and the apparent lack of systematic ratios for these elements indicate their origin to be largely empiric. The presence of the smaller fractional percentages of certain elements is probably to be ascribed to the use of insufficiently refined metals in the manufacture of the alloys.

The details of procedure for accurate chemical analyses of these complex alloys cannot be given in this paper but will be arranged in detailed manner for later publication.

2. Micrographs illustrating the structures of a number of alloys show that these structures are characteristic for alloys of this general type receiving such mechanical and heat treatment. They are presented chiefly as a further identification of the alloys tested.

3. A method of securing fusion temperatures is described. The fusion temperatures of these alloys are shown to vary from 895 C. (1645 F.) to 1410 C. (2570 F.). The fusion temperature listed is the temperature at which the alloy falls apart readily and is within the freezing range of the constituents. This is given as the important temperature, since it is at this value the alloy loses most of its coherence, and is the upper limit for soldering, hot bending and other similar operations.

4. Definite methods of heat treatment and operative technic have been established which will produce a maximum of desirable qualities in these alloys.

5. In testing for the mechanical properties of a number of alloys which are given, it has been found that the alloys sold for orthodontic and prosthodontic use are widely divergent in physical properties. It is evident that some of these are unsuited for high grade work.

The static flexure, the tensile and the flexure life tests are offered as methods for grading alloys.

6. The greatest value to the profession of the details and methods for accurate standardization of gold alloys for use in orthodontia and prosthodontia, herewith described, should arise from the introduction of these methods in the dental school and research laboratory.

DIFFERENTIAL DIAGNOSIS OF CERTAIN ORAL LESIONS

By CHALMERS J. LYONS, D.D.Sc., Ann Arbor, Michigan

(Read before the American Dental Association, Dallas, Texas, November 10-14, 1924)

ONE of the most important phases of twentieth century medical and dental practices should be that of diagnosis. This field has been more or less neglected by both medicine and dentistry and, as a result, the treatment of disease is sometimes made when the disease itself has not been identified. A few definitions may be of some help.

Just what do we mean by the term diagnosis? Berger[1] defines the term comprehensively in these words: "Diagnosis is the sum total and correlation of the history, the clinical findings, and the results of the various specialized methods of examination." We fail in making a diagnosis when less is accomplished in our examinations than is outlined in this definition. A definition of the term that I like, and that is a little simpler in its phraseology, but just as far-reaching in its meaning is this: "Diagnosis is the result of the process of applying the mind to a collection of scientific data." It must be obvious, then, if we are to accept either of the foregoing definitions, that more than a superficial examination of the patient must be made when we are striving to determine the cause or the character of a disease.

Having now clearly in mind the explanation of the meaning of the word diagnosis, let us go a little further and define the term differential diagnosis. It is defined in medical dictionaries as "the qualitative distinguishing between two diseases of similar character by comparative symptoms." Therefore, in making a differential diagnosis, it is necessary to be able to differentiate the normal from the pathologic, and the normal should not be confused with conditions that are ideal.

In the clinical study of the pathologic, Berger[1] points out several factors that should be taken into consideration: 1. The subjective symptoms. 2. The alteration in the anatomic outline and relationship. 3. The structural changes in the compromised tissues. 4. The impairment or aberration of function. 5. The involvement of the directly or indirectly associated structures or remote organs. 6. The reaction on the general health of the individual.

In making a sane and judicial diagnosis, all of the foregoing factors should be considered, and by their consideration the requirements of both definitions of the term diagnosis will have been fulfilled.

We shall discuss the subject of differential diagnosis of certain oral lesions under the following heads: 1. Those that arise as a result of infection. 2. Those that arise as a result of trauma or of abnormal development of tissue. 3. Those that arise as a manifestation of disease in other parts of the body.

Under the first head will come that disease which has become so common since the war, Vincent's infection. The lesion is associated with a mixed invasion of fusiform bacilli and *spirocheta vincenti*.[2] The fusiform bacillus was

1. Berger: Principles and Technic of Oral Surgery, New York, Dental Items of Interest Publishing Company, 1923.

2. Lyons, C. J.: Some Pathological Conditions of the Mouth and Their Treatment, New York M. J., 109: 191 (Feb. 1), 1919.

first described by Miller in 1883, who found that the infection occurred in clean as well as unclean mouths. During the closing years of the nineteenth century, Vincent, a physician practicing in Paris, wrote extensively on both the organism and the clinical findings. It was he who applied the name Vincent's angina to this condition.

There are two prominent etiologic factors in this disease. First, oral sepsis favors its development. The disease is frequently found around pyorrheal pockets, and gum flaps overhanging lower third molars, where it is difficult to keep food deposits and débris from collecting. Second, the disease is frequently found in mouths of individuals whose resistance has been lowered either by acute or by chronic disease. It is infectious and, in certain localities and sometimes under favorable conditions, has become epidemic. It is characterized by a marked tissue necrosis, the tissue being covered by a whitish gray membrane. This membrane is easily removed, and, when rubbed off, exposes a granular, raw, bleeding base, which leads to crater-like ulcers with irregular edges.

Barker and Miller[3] classify the symptoms as follows:

> Objective signs—insignificant constitutional disturbances; as a rule the patient is not very ill; absence of high fever, the temperature rarely rising over 100 to 101 degrees; heavy and offensive breath; enlargement of the cervical and lymphatic glands, which is moderate as a rule; they are tender but never suppurate; the gums are swollen and spongy and suggestive of scurvy.
>
> Subjective symptoms: The patient complains of extremely bad taste in the mouth; tenderness of the gums, so that the use of a toothbrush is impossible and mastication is so painful as to preclude eating; pain in swallowing; looseness of the teeth with salivation, which is common, resembling mercurial ptyalism; anorexia nearly always present, joints are painful and a deep feeling of lassitude and mental depression are the most serious constitutional symptoms.

Many mild cases of Vincent's infection may be mistaken for catarrhal stomatitis, but a smear of the secretions will usually demonstrate the fusiform bacillus and *spirocheta vincenti.* The prognosis is usually favorable, and most cases run a benign course.

There are several oral diseases that may be confounded with this disease. Several of the other forms of ulcerative stomatitis may simulate Vincent's infection. In the early stages of mercurial stomatitis, the symptoms may be almost identical; yet usually, in these cases, a history of ingestion of mercury as an antisyphilitic treatment or in overdoses of calomel may be obtained. In secondary syphilis, the mucous membrane of the larynx, pharynx, and gingiva may present a highly inflammatory condition with bleeding; but, in such cases, little or no pain accompanies the lesion, while, in Vincent's infection, pain is always an accompanying symptom. Age seems to play an important part in the incidence of Vincent's infection. It is most common under 35, but rarely found in childhood. It was formerly thought that there was a relation between this disease and syphilis as both have a spirochete as a predominating micro-organism, but they have no apparent relation to each other.

Syphilis is defined by Wile[4] as "a disease peculiar to the human race, chronic in its course, intermittent in the character of its symptoms, acquired or transmitted through two or three generations and capable of affecting any organ of the body." The primary period is characterized by a chancre and an attendant bubo. The chancre may appear on almost any organ or surface of the body, but the only sites that we shall consider in this paper are the lips and the oral cavity. The finding of the bubo of syphilis is more constant than the finding of a chancre. When a chancre is present on the lower lip, the bubo involves the lymphatic glands of the sternocleido-mastoid region, and, when it is present on the upper lip, the

3. Barker, L. F., and Miller, S. R.: Vincent's Angina, J.A.M.A., 71: 793 (Sept. 7), 1918.

4. Wile: Unpublished lectures.

anterior auricular glands and the cervical lymphatic glands are involved.

The bubo does not appear simultaneously with the disappearance of the chancre, but remains for a longer period. It is characterized by being painless, with a slight feeling of fullness and discomfort. It is an important diagnostic point in primary syphilis. It is caused by a marked increase in the lymphogenous elements of the neighboring lymph glands due to metastasis.

Spirochaeta pallida may be found in the lymph gland when the chancre is not demonstrable. The chancre appears first as a small red macula, which rapidly increases in size and looks like an eroded nodule or papule. It is surrounded by an area of thickening tissue, which is later destroyed by ulceration. The tissues contiguous to the lesion are indurated, and the lesion itself appears to be a foreign body in the tissues. The lips are a common site for the chancre. It often appears in the peritonsillar region and is more difficult to diagnosis. Here it resembles Vincent's infection in its location and appearance, as it will frequently be found in the crypts of the tonsil. Again, the presence or absence of pain will be a factor to aid in making the diagnosis. Chancre of the gums is relatively rare, but may be found on the hard and soft palates. The chancre may be mistaken for carcinoma, and vice versa.

The differential diagnosis between these two lesions may be summed up as follows: Both lesions are hard; the carcinoma is infiltrated, attaching itself to the underlying structures, while the chancre is indurated and circumscribed. The carcinoma has a bloody discharge, the chancre has a serous discharge; the carcinoma is painful, the chancre is painless. The carcinoma has an irregular border, which appears to roll out on account of the heaped-up epithelial cells; while the chancre has a regular well defined border. Adenitis in chancre comes on early; while, in carcinoma, it comes on comparatively late, and is marked evidence that metastasis to other parts of the body has taken place.

Secondary syphilitic manifestations are usually of an erythematous or ulcerative type, commonly seen on the oral pharynx as an area of inflammation. As in the primary state, these areas are painless, or nearly so. These areas appear as mucous patches and may be observed on the tip or the dorsum of the tongue, or running back over the azygos uvule and the fauces. These mucous patches can be differentiated from leukoplakia buccalis in obtaining a history of the case. The mucous patches of leukoplakia buccalis arise from an irritation to the mucous membrane, such as is caused by a quid of tobacco, or by smoking, or results from the mucous membrane's being changed by chemicals or by trauma.

Tertiary syphilitic manifestations are sometimes seen in the mouth as gummatous ulcers. These may be mistaken for carcinoma if on the cheek or tongue. In fact, carcinoma may have its origin in the irritation produced by an old syphilitic ulcer. It has been stated that in 30 per cent of the patients suffering from epithelioma of the tongue, a history of former syphilis can be obtained, and in a large percentage of cases, the site is an old syphilitic lesion.

Brown[5] points out that gumma never appears on the under surface of the tongue but always on the dorsal surface and that it is accompanied by leukoplakia. In appearance, it is a deep sloughing ulcer, with its edges undermined and more or less sharp. The base of the gumma is indurated, while that of carcinoma is infiltrated. There is less tendency of the gummatous ulcer to hemorrhage, and the odor and discharge are not quite so offensive.

On the tongue, the gumma usually appears more or less over the whole dorsal surface, while the carcinoma is

5. Brown, G. V. I.: Oral Diseases and Malformations, Philadelphia, Lea & Febiger, Ed. 3, 1919.

usually on one side. Diagnosis of syphilitic lesions of the mouth is not always a simple matter, as the history of the patient is not always reliable. While all syphilitics will not give a positive reaction to the Wassermann test, it is very rare that a positive reaction cannot be obtained in the presence of active syphilis. Microscopic and laboratory tests should always be used before one concludes a diagnosis of these lesions that so closely simulate each other in superficial appearance, and whose origin, progress and treatment must be so far diversified.

We will now discuss briefly some of these lesions occurring in the oral cavity as a result of trauma or of abnormal development of tissue. In this class will be included the neoplasms found in the mouth.

Mills,[6] an English surgeon, gives the following definition for tumors, which clearly illuminates their peculiar character and habits: "A tumor is a new growth of tissue or cells arising without known cause and continuing to grow on its own account without regard to the growth or nourishment of the individual in which it is forming." It serves no useful purpose and comes to no physiologic termination. The growths that occur most frequently in the oral cavity are sarcoma, carcinoma, epulis, odontoma and cyst. In making a differential diagnosis of tumors of the oral cavity, Scudder[7] informs us that the following points should be considered: the history of the tumor; its exact time of appearing; its precise location at the beginning; its size when first detected; the rate of growth; the jaw involved (maxilla or mandible); the possibility of trauma; condition of the teeth in early and adult life; associated conditions of pain, discomfort and deformity; and the presence of glandular enlargement, metastatic growth, cachexia, syphilis and tuberculosis. The most serious of these lesions are sarcoma and carcinoma, both of which may be malignant and may occur all too frequently in the oral cavity.

The only hope of reducing the high mortality rate from these lesions lies in educating the public that any abrasion or abnormal condition of the structures of the oral cavity may produce malignancy after the age of 35. In all hospital clinics, inoperable cases are being presented daily. Many of these lesions have been seen by the dentist and some by the physician in their incipiency. If we are to hope for a cure in these cases, surgical interference must be resorted to before metastasis has taken place. If this statement is true, and there is abundant evidence that it is, it must be obvious that our greatest hope in the cure of malignancy lies in the very early recognition of the disease. Aud,[8] in a study on "Early Diagnosis and Treatment of Cancer of the Mouth" makes this statement: "Largely because of neglect and ignorance, nine cases out of ten are now fatal." While most of the responsibility for this condition rests with the patients themselves, it is indeed a sad commentary that a part of it is due to negligence of the dentist. Statistics show that about 3,500 people a year die of cancer of the mouth. One of the basic principles in the etiology of carcinoma is that of constant irritation.

The oral cavity is peculiarly subjected to irritation and trauma on account of the character of its tissues, its habits and its environments. There we have the irritation produced by erupting teeth; by smoking; by broken-down roots; by abraded teeth in middle life; and, in some mouths, by poor dentistry, such as rough fillings and ill-fitting plates and crowns, so that areas of the mucous mem-

6. Mills, G. P., and Humphrey, Humphrey: A Text Book of Surgery for Dental Students, London, Edward Arnold, 1919.

7. Scudder: Tumors of the Jaws, Philadelphia, W. B. Saunders Company, 1912.

8. Aud, Guy: Early Diagnosis and Treatment of Cancer of the Mouth, J.A.D.A., 11: 854 (Sept.), 1924.

brane are constantly being subjected to irritation, with a resultant inflammation.

A good rule to follow is that any lesion of the mucous membrane, no matter how small, that cannot be accounted for by dental disorders should be looked on with grave suspicion, and steps should be taken to eradicate it at once, and the tissues so removed be subjected to a microscopic examination.

Carcinoma may appear in any part of the oral cavity. Carcinoma of the mandible or maxilla may be secondary to carcinoma of the cheek or lips. It may first be observed on the surface of the mucous membrane of the oral cavity as a shallow ulcer, or on the lips as a fissure with radiating lines; or it may appear, in its precancerous stage, as leukoplakia. In fact, in cases in which an excessive use of tobacco, either smoking or chewing, is the etiologic factor, it nearly always has its beginning as leukoplakia. Such a condition is characterized by white elevated patches irregular in outline and not sensitive. The lesion does not respond to treatment by drugs, but recedes and advances without known cause. This condition may be differentiated from ulcerative stomatitis by the presence or absence of pain. Leukoplakia advances without pain. There is extreme danger of malignant degeneration taking place, with this lesion, becoming carcinoma.

Carcinoma is more frequently found in the oral cavity than is sarcoma, the ratio being about 3:2, and is more common in men than in women. It occurs definitely at a later period of life than does sarcoma. Carcinoma seems to flourish between 40 and 60 years of age; while sarcoma selects youth and middle life in which to develop. Sarcoma involves the body of the bone; while carcinoma involves the jaw first along the alveolar borders. A chronic abscess may be mistaken for a carcinoma by its superficial appearance, the granulation tissue surrounding the fistula taking on a cauliflower appearance. The character of the secretion plus the roentgenographic findings will differentiate the conditions. The odontomas, either the follicular or composite, usually make their appearance in patients under 30 years. These tumors may have been present for years before the patient has resorted to treatment; while a carcinoma or sarcoma, in a year or two, would cause death or marked deformity of the parts. When a history points to growth of several years, the tumor is likely to be benign.

The follicular odontoma or dentigerous cyst may be confused with osteosarcoma. The point of interest in common with these two lesions is that they may occur in either jaw, and are characterized by marked swelling. Both are painless in their formation. The growth is comparatively slow and either may attain great proportions without any discomfort to the patient or even a knowledge of their presence, until some important structures are involved. As a rule, no inflammation is present, and the mucous membrane overlying the lesion is normal in color.

The differential diagnosis may be made by means of the roentgenogram. The follicular odontoma casts a shadow showing an area of rarefaction in the body of the bone with a very definite outline of a tooth or parts of a tooth in the cavity; while that of the osteosarcoma shows a somewhat denser than normal shadow of the bone, with a mosaic appearance of the trabeculae. On palpation, the follicular odontoma produces a sensation such as is received on palpating parchment; while that of the osteosarcoma is firm and hard and at once conveys the impression of its being dense bone.

On account of the thinness of the wall of the follicular odontoma, it can be aspirated, the contents being of an amber color; while the osteocarcinoma cannot be penetrated with a needle without considerable effort, and no fluid may be obtained from its substance.

The composite odontoma may be dif-

ferentiated from either the sarcoma or follicular odontoma by means of the roentgen ray. This tumor, which is made up of the structures that enter into the formation of a tooth, presents a disorderly mass of cementum, dentin and enamel. It develops without pain or discomfort to the individual, is probably self-limiting in its growth and is considered benign. The roentgenogram reveals at once the character of the tumor.

The tumor commonly known as an epulis usually is of slow growth at first and is attached by a slender stalk from the periosteum. This tumor occurs more frequently in women than in men. Broodgood believes it stands between the really benign and the slightly malignant. Age is a factor in determining whether this tumor may be ruled out in a differential diagnosis. It occurs usually in young adults. There are two varieties, the fibrous and the giant-cell. The fibrous epulis is ordinarily of small size, projecting between two teeth and spreading somewhat over the alveolar border. It may become calcified extensively or in limited areas throughout its substance. It is smooth and quite firm on the surface, not very vascular and does not bleed easily; while the giant-cell epulis is soft and irregular, containing myriads of vessels, and bleeds easily when disturbed.

We will now consider a few of those disturbances in the oral cavity that arise as a manifestation of disease in other parts of the body. Probably the most common of these lesions that are of dental interest are the herpetic lesions. Such lesions may appear on the tongue and buccal mucous membrane, where they are called by the laity "canker sores." On account of the relation of these lesions to digestive derangements, the ulcers are sometimes spoken of as "dyspeptic ulcers." The lesions consist of closely aggregated vesicles, varying in size from that of a pin-head to a surface 1 cm. in diameter. They are grouped in distinct clusters, which are seated on an inflammatory base. They are extremely sensitive and frequently present a burning sensation. A history of recent formation with the general clinical appearance and extreme sensitiveness will differentiate the condition from chancre. Any of the exanthematous diseases may, and usually do, produce manifestations of the disease in the mucous membranes of the oral cavity. Smallpox, scarlet fever and measles early involve the mucous membranes. In scarlet fever, one of the early symptoms is marked inflammation of the uvulae, tonsils and soft palate. In the more severe cases, the inflammation increases and the mucous membrane becomes swollen and edematous. The tongue is, as a rule, heavily covered with a grayish white coating at the onset of an attack of scarlatina. Soon the tip and edges assume an angry reddish coloration and a roughened granular appearance. This condition, which has been described as the "raspberry tongue," is of considerable diagnostic importance. From the second to the fifth day, there will often be seen on the gums white patches resembling a phenol burn or a patch of leukoplakia. These patches represent a desquamation of the epithelial covering of the gingival mucous membrane and will readily rub off on slight friction. This process may also occur with measles and smallpox. In pernicious anemia, there is a characteristic phenomenon going on in the oral cavity. It is manifested as a chronic superficial glossitis. A large area of the dorsal aspect of the tongue is much smoother than normal, the papillae having entirely disappeared. The mucous membrane is hyperemic, and not uniform in color, as in the normal state. It is uneven and often presents smooth and elevated areas. The surface presents a glossy appearance with bluish white patches.

CONCLUSION

The oral cavity presents many interesting pathologic conditions that from the standpoint of diagnosis cannot be overlooked in the consideration of both

local and systemic disease. The dentist should study the normal mucous membrane from the standpoint of color, anatomic outline and relationship, and when a situation arises that deviates from the normal, his suspicions should be aroused and steps should be taken to identify the condition.

DISCUSSION

S. L. Silverman, Atlanta, Ga.: I wish that I knew more of differential diagnosis and less of diagnosis. That really is the most important thing, not only in oral surgery but in general surgery and in general medicine. We are wont to criticize the general surgeon because he mistakes a minor affection of the mouth and immediately takes steps to perform either a partial or a total resection of the jaw. I quite agree with you that the general surgeon or anyone else who takes it on himself, on a snap diagnosis, to perform a radical operation for the removal of a jaw is to be censured and criticized.

Let's look at the other side, and that is the side that Dr. Lyons brought out in his paper. How about the general dentist and the general oral surgeon or anyone else who will extenuate a condition in the mouth because this particular patient happens to be a member of some good family or friend and say, "Ah, this is merely nothing, it will pass away in a few days," and the condition finally results in something, so that when the jaw is removed, it is already too late to save that patient's life? Patients who have lesions about the mouth are often the victims of the ultraconservative or the ultraradical men in both professions. Neither attitude is correct, and here the term differential diagnosis comes in; to be able to diagnose between a condition and a like condition.

How often have you heard of, probably some of you have seen, a case in which a typhoid patient is about to be operated on for appendicitis? It is easy to make that mistake, but to be able to differentiate between typhoid and an acute appendicitis constitutes the art of differential diagnosis. I have seen personally, and I know a good many of you have seen, cases in which any tumefaction about the mouth was looked on by the oral surgeon as a malignant condition, necessitating the removal of the jaw affected. On the other hand, how many times have I seen a family physician or a family dentist extenuate a condition, telling the patient merely to take some purgative, use a mouth wash or take some other simple steps, thus postponing surgical interference until surgery could no longer benefit? How many times have I heard men talk about carcinoma and sarcoma, and when asked whether the condition was a sarcoma or carcinoma, answer, "What difference does it make? Those particular men are supposed to know something about malignant and benign conditions of the mouth, are supposed to know which growths are capable of metastasis and which growths require lymphatic removal.

Unless a man is willing to study and go into these phases of oral surgery, general surgery and medicine, so that he cannot only make a diagnosis as regards the patient's immediate comfort but also can ward off an operation in time to come that is not only mutilating as far as facial appearance is concerned (when this differential diagnosis has been missed) but also results in death, he will not be able to make a differential diagnosis. I do not mean to say that Dr. Bloodgood or that his predecessor, Dr. Bull, or I or anyone else is capable every time of making a differential diagnosis in lesions of the mouth. I do not claim that; but I claim this: every growth starts from a microscopic speck, internal or external. It starts microscopically and ends macroscopically. If we could stop every growth, every lesion that is visible to the naked eye, we would not see people walk along with growths that are not only deforming but add additional weight to the patient.

J. A. Blue, Birmingham, Ala.: We should regard any lesion of the mouth, it makes no difference how small, with suspicion until its exact nature has been proved. It is a well known fact that cancer, if diagnosed and treated in the early stages, is susceptible of permanent cure.

It is nothing short of a crime for us to neglect these suspicious cases, allowing them to progress under our supervision. Sharp margins of teeth and roots were mentioned by Dr. Lyons. It is impossible to consider these conditions too seriously. It is impossible to tell what may happen in a case of continued irritation from a sharp margin of a tooth or a jagged root surface that is invariably infected, it makes no difference how clean the mouth may be kept. We should at all times keep ourselves on guard, looking out for syphilitic lesions, for both our own protection and the protection of the public. By taking these conditions in hand in the early stages and directing their treatment into the proper channels, we can do much good.

FURTHER STUDIES ON ELECTIVE LOCALIZATION OF BACTERIA FROM INFECTED TEETH*

By JOHN G. MEISSER, D.D.S., Cleveland, Ohio

IT HAS been my privilege, during the last four years, through the cooperation of physicians in various divisions of the Mayo Clinic, to study experimentally and clinically the relationship between dental infections and various systemic diseases. The results of such studies have been published from time to time in collaboration with Rosenow, C. H. Mayo, Bumpus and other members of the staff.[1] I shall here review briefly the results of the early experiments, and report in detail the results of further experiments along similar lines.

In the earlier experiments, the localizing power of freshly isolated strains of bacteria from infected teeth was measured by intravenous injection into rabbits. The technic employed in isolating the bacteria and injecting animals was that employed by Rosenow in his studies on focal infections.[2] Streptococci, either in pure culture or as the predominating organisms, were found in cultures made from granulomas and from scraping from the apices and the canals of pulpless teeth. The streptococci were always of the nonhemolytic type and of a low grade of virulence. Although culturally much alike, when injected into animals they produce different lesions, similar to those in the patient from whom the bacteria were isolated.

Since the report, in 1922, on the elective localization of bacteria from the infected teeth of patients with various diseases,[3] many other patients have been studied, and many animals infected,

*Work done in the Division of Experimental Bacteriology, The Mayo Foundation, and in the Section on Dentistry, Mayo Clinic, Rochester, Minn.

1. Bumpus, H. C., and Meisser, J. G.: Focal Infection and Selective Localization of Streptococci in Pyelonephritis. Study I. Arch. Int. Med., 27: 326-337 (March) 1921; Foci of Infection in Cases of Pyelonephritis. Study II. J.A.M.A., 77: 1475-1478 (Nov. 5) 1921. Mayo, C. H. and Meisser, J. G.: Dentistry and Its Relation to Preventive Medicine, Dent. Summary 43: 5-14, 1923. Meisser, J. G., and Brock, Sam: A Clinical and Experimental Study in Chronic Arthritis, J.A.D.A., 10: 1100-1110 (Dec.) 1923. Meisser, J. G., and Bumpus, H. C.: Focal Infections in Relation to Submucous Ulcer of the Bladder and to Cystitis, J. Urol., 6: 285-298 (Oct.) 1921. Meisser, J. G., and Gardner, B. S.: Elective Localization of Bacteria Isolated from Infected Teeth, J.N.D.A., 9: 578-592 (July) 1922. Rosenow, E. C., and Meisser, J. G.: Elective Localization of Bacteria Following Various Methods of Inoculation, and the Production of Nephritis by Devitalization and Infection of Teeth in Dogs, J. Lab. & Clin. Med., 7: 707-722 (Sept.) 1922; The production of Urinary Calculi by the Devitalization and Infection of Teeth in Dogs with Streptococci from Cases of Nephrolithiasis, Arch. Int. Med., 31: 807-829 (June) 1923.

2. Meisser, J. G.: Focal Infection as a Cause of Diseases of the Urinary Tract, J.A.D.A., 10: 610-618 (July) 1923. Rosenow, E. C.: The Etiology of Acute Rheumatism, Articular and Muscular, J. Infec. Dis., 14: 61-80, 1914; Elective Localization of Streptococci, J.A.M.A., 65: 1687-1691, 1915; The Pathogenesis of Focal Infection, J.A.D.A., 5: 113-124 (Feb.) 1918; Studies in Elective Localization. Focal Infection with Special Reference to Oral Sepsis, J. Dent. Res., 1: 205-267, 1919. Rosenow, E. C. and Ashby, Winifred: Focal Infection and Elective Localization in the Etiology of Myositis, Arch. Int. Med., 28: 274-311 (Sept.) 1921.

3. Meisser: Footnote 1, sixth reference.

TABLE 1.—LOCALIZATION OF STREPTOCOCCI FROM DENTAL FOCI OF INFECTION

Disease	Strains, 210	Animals injected, 660	Percentage Incidence of Lesions in											
								Stomach						
			Kidney	Bladder	Urinary tract	Joints	Muscles	Hemorrhages	Hemorrhage and ulcer	Duodenum	Endocardium	Myocardium	Nerves	Gallbladder
Ulcer of the stomach	22	81	15		15	12	9	67	33	1	1		1	
Pyelonephritis	29	111	76	14	78	17	7	10				4		2
Cystitis	10	48	71	46	87	4	10	8		2	4			6
Arthritis	75	239	10		10	67	35	9	1		1	1		1
Myositis	8	26	8		8	27	81	15				8	8	
Hematuria	7	22	32	5	32	14	5	9						5
No definite diagnosis	59	133	5		5	10	15	8			2	5		

some by the intravenous injection of bacteria from the infected teeth of patients and others by the production of chronic foci (Table 1).

The figures in Table 1 are directly comparable and indicate the percentage incidence of lesions in the various organs of all animals used in the experiments. A total of 660 rabbits were injected with bacteria from the infected teeth of 210 patients.

Of the eighty-one rabbits injected with cultures obtained from the infected teeth of twenty-two patients with ulcer of the stomach, 67 per cent developed hemorrhagic lesions of the stomach, and 33 per cent developed ulcers and hemorrhages. Lesions in other organs were comparatively slight. Two of the patients had had recurring attacks of ulcer with hemorrhage, and each had had a gastro-enterostomy. At the time of operation, no attention was paid to foci of infection. One patient had a return of gastric symptoms within fifteen months after operation, and roentgenograms revealed an ulcer along the lesser curvature. A search for foci of infection at this time revealed infected tonsils and nine pulpless teeth, all showing evidence of periapical infection. The infected teeth and tonsils were removed. Twenty-six rabbits were injected intravenously with cultures from the infected teeth. Twenty-two of the twenty-six rabbits developed hemorrhagic lesions in the stomach; thirteen of these also developed ulcers (Fig. 1).

The kidney was affected in only three rabbits. One had a few lesions in muscles, one a slight involvement of the joint, and one endocarditis. These lesions were relatively slight compared to those in the stomach. After the removal of infected teeth and tonsils and the administration of an autogenous vaccine, the patient's gastric symptoms gradually disappeared.

The other patient, who had had a gastro-enterostomy, harbored five pulpless teeth, four of which showed evidence of infection in the roentgenogram. The teeth were removed and cultured, and a green-producing streptococcus was recovered from each, including the tooth that was negative in the roentgenogram. Six rabbits were injected intravenously and five developed hemorrhagic lesions in the stomach. Four of the five had definite ulcers also. After removal of the infected teeth (about four years ago), the patient's symptoms gradually disappeared; the ulcer did not recur.

Lesions occurred in the kidneys of 76 per cent of 111 rabbits injected intravenously with streptococci from the dental foci of twenty-nine patients with pyelonephritis. Lesions in other organs

were comparatively slight. The marked specificity of the streptococci for renal tissue in these patients is of particular interest because it has been generally believed that pyelonephritis was due to colon bacillus infection. The urine of such patients practically always contains the colon baccillus. From a careful ex-

Fig. 1.—Lesions in pyloric end of rabbit's stomach, produced by intravenous injection of streptococci isolated from dental foci of patient with gastric ulcers.

perimental and clinical study it has been demonstrated[4] that the streptococcus is generally the cause of the disease and the colon bacillus is a secondary invader. In many instances, following the removal of infected teeth that harbored only streptococci, the pus and albumin and the colon bacilli gradually disappeared from the urine.

Forty-eight rabbits were injected intravenously with streptococci isolated from the infected teeth of ten patients whose chief complaint was cystitis, but who also suffered with mild nephritis. Of these rabbits, 46 per cent developed lesions in the urinary bladder, and 71 per cent lesions in the kidney. It is of interest to compare the 87 per cent localization in the urinary tract with the relatively few lesions elsewhere (Table 1).

The streptococci isolated from the infected teeth of seventy-five patients with various types of chronic arthritis were injected intravenously into 239 rabbits. The joints became infected in 67 per cent, and certain muscles in 35 per cent. This percentage is somewhat lower than that noted in my first study on elective localization, in which 81 per cent of animals injected developed arthritis. However, the first series of patients were selected, and all had either an acute or subacute form of the disease; while the present series includes patients studied routinely, regardless of type or duration of the disease.

In a previous report,[5] it was demonstrated that arthritis does not occur so often in animals injected with streptococci from dental foci in cases of chronic proliferative or degenerative arthritis as in those injected with streptococci in more acute cases.

Only eight patients with myositis were studied, and of twenty-six animals injected twenty-one developed lesions in muscles. Many patients with myositis complained of pain in the joints, while many with arthritis complained of pain in the muscles. This undoubtedly explains the relatively high percentage of the localization of lesions in the muscles of rabbits with arthritis and in the joints of rabbits with myositis, and agrees with the findings of a much larger group of similar cases.[6] Lesions in organs and

4. Bumpus and Meisser: Footnote 1, first, second and sixth reference.

4. Meisser and Brock: Footnote 1, fifth reference.

6. Rosenow and Ashby: Footnote 2, sixth reference.

tissues other than muscles and joints were comparatively slight.

Seven patients with hematuria were studied. Although none of the animals injected developed typical hematuria, seven of the twenty-two developed lesions in the kidneys. The patients improved markedly following removal of the dental foci from which the organisms injected into the animals were isolated. In order to produce hematuria experimentally, it may be necessary to use a method other than intravenous injection.

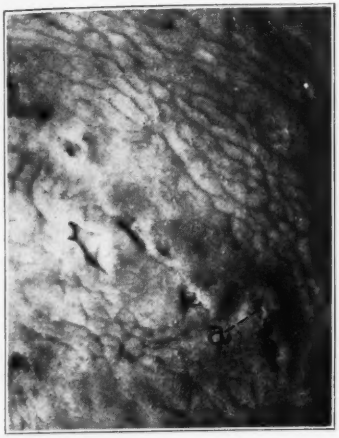


Fig. 2.—Lesions of the stomach in a dog whose cuspids were devitalized and injected many months previously with the streptococcus from an ulcer.

The results in the 133 animals injected with cultures from a group of patients not suffering from systemic disorders served as controls. The size of the dose and the duration of the experiments in the different groups were comparable.

Results from Chronic Dental Foci of Infection

It was thought possible that even more specific effects might be obtained by simulating more closely the condition found in patients by producing chronic foci in animals through the devitaliza-

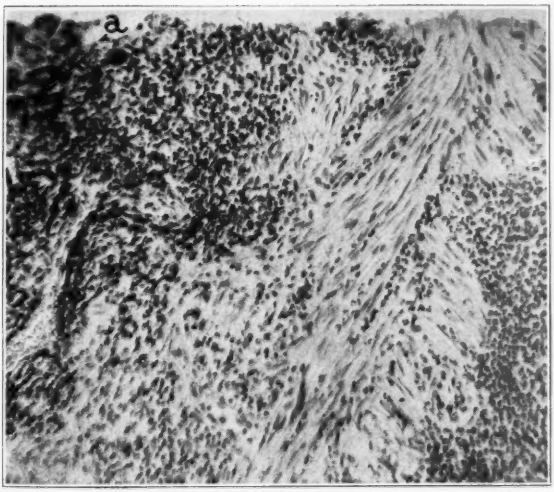


Fig. 3.—Microscopic sections of ulcer shown in Figure 2 at *a*. Marked leukocytic and round-cell infiltration, and increase in connective tissue may be noted. Hematoxylin and eosin; × 60.

tion and infection of teeth. The chronic foci produced experimentally would furnish a continuous supply of bacteria over a long period of time, and thus it might be possible to produce certain chronic diseases, suggested by clinical observation to be the result of infection, which have not been induced by intravenous injection. This has been done in

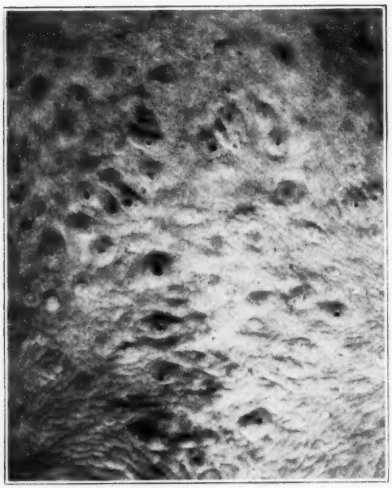


Fig. 4.—Peptic ulcers in a dog whose teeth were devitalized and infected many months previously with streptococci from the infected tonsils of a patient with chronic ulcers of the stomach.

cases of nephritis and nephrolithiasis,[7] and the following technic developed:

The animals were well nourished, healthy dogs. In order to devitalize the teeth in a sterile manner, the dogs were placed on an operating table and etherized by the intratracheal method. The teeth to be infected were isolated by a rubber-dam, which covered upper and lower jaws. The animal was covered with a sterile sheet and towels, only the rubber-dam and isolated teeth remaining visible. These were carefully scrubbed with tincture of iodin and alcohol, and cut off midway between the incisal edge and gum margin with sterile bone nippers. The pulps were removed with broaches that had been flamed, and the bacteria from the foci of the patient introduced into the pulp chambers. The canals were then sealed with sterile guttapercha and heated copper amalgam.

Of the twenty dogs in each of whom four cuspids were infected with streptococci isolated from the infected teeth of three patients with ulcer of the stomach, thirteen (65 per cent) developed hemorrhagic lesions in the stomach, and 45 per cent revealed beginning ulceration as well (Table 2). No lesions were found in other organs. The gross appearance of the gastric ulcers of these dogs resembled, in many respects, those produced by Rosenow[8] in dogs by intravenous injection. They were most numerous near the pylorus and along the lesser curvature, and usually resembled so-called peptic ulcers because the mucous membrane had a punched-out appearance with clean margins and base. In some instances, the margins were swollen, opaque and granular; in others, the mucous membrane was swollen and opaque, but not yet ulcerated (Figs. 2 and 4).

Microscopic examination of sections through the ulcer-bearing surface, and areas showing infiltration and swelling without ulceration, disclosed a variable degree of leukocytic and round-cell infiltration, usually most marked between tubules, but often extending into the submucosa for a considerable distance beyond the ulcerating or swollen area. Thrombosis was found only once, although a moderate leukocytic accumula-

7. Rosenow and Meisser: Footnote 1, seventh and eighth reference.

8. Rosenow, E. C.: The Causation of Gastric and Duodenal Ulcer by Streptococci, J. Infec. Dis., 19: 333-384, 1916.

8. Rosenow and Meisser: Footnote 1, eighth reference.

tion was occasionally found within the blood vessels in the submucosa. In certain cases, there was connective-tissue hyperplasia in which were nests of more acute inflammatory reaction, as indicated by infiltration of polymorphonuclear leukocytes (Figs. 3 and 5).

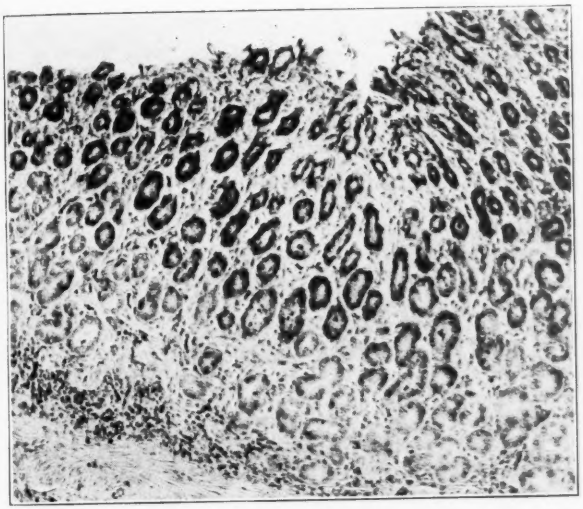


Fig. 5.—Section of one of the chronic ulcers shown in Figure 4. Increase in connective tissue between the tubules and the leukocytic and round-cell infiltration in the submucosa may be noted.

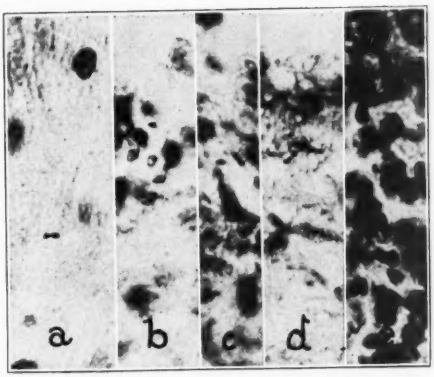


Fig. 6.—Diplococci in ulcers shown in Figures 2, 3, 4 and 5.

A careful search for micro-organisms in sections stained by Gram's method revealed diplococci and short chains,

most numerous in the sloughing tissues, the interstitial spaces surrounding the tubules in the ulcerating areas (Fig. 6*a*) and in the base of the ulcerating areas (Figs. 6*b*, *c* and *d*). They were also demonstrable at a considerable distance from the ulcerating surface in the infiltrated areas in the submucosa Fig. 6*e*), but not in normal tissues remote from the ulcerated or infiltrated areas.

The experiments on the thirteen dogs that developed lesions in the stomach lasted from two weeks to a month in four cases, from three and one-half to five and one-half months in three, nine months in two, and from a year to a year and three months in four. The seven negative experiments lasted five months in one case, a year and three months in another, and from eight and one-half to nine months in five.

Fig. 7.—Appearance of the upper jaw of a dog that developed gastric ulcer. The area of rarefaction around the apex of a devitalized cuspid may be noted.

Roentgenograms of the jaws disclosed rarefaction around the apices of the devitalized teeth in most of the dogs (Fig. 7). The few dogs with negative roentgenograms were very old, and the pulp canals were so small that a very fine broach could be inserted only part way. Sections of granulomas removed from the apices of the devitalized teeth contained variable degrees of leukocytic and round-cell infiltration (Fig. 8). Diplococci and streptococci were found in the areas of cellular infiltration (Fig. 9).

At necropsy, cultures were made from material in the pulp canals of one or more of the devitalized teeth in each dog. The streptococcus was recovered in pure culture from the infected teeth of seven of the thirteen dogs that developed gastric lesions, and was the pre-

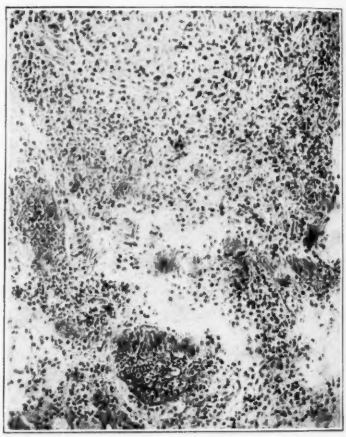


Fig. 8.—Section from granuloma removed from cuspid shown in Figure 7. Area of round-cell and leukocytic infiltration may be noted. Hematoxylin and eosin; × 40.

dominating organism with gram-negative and gram-positive, gas-producing bacilli in the remaining six. These cultures were injected intravenously into rabbits to test their localizing power, and ulcer of the stomach developed in nearly all (Fig. 10). They resembled closely those obtained following devitalization and infection of teeth in dogs, except that the lesions were more acute and the streptococcus was more easily demontrable in the lesions (Fig. 11).

Cultures made from the devitalized cuspids of the seven dogs with negative roentgenograms yielded streptococci in

four, gram-negative and gram-positive, gas-producing bacilli in two, and gram-negative bacilli and streptococci in one. The streptococcus introduced into the teeth at the time of devitalization had disappeared in two dogs and had almost disappeared in a third because of secondary invasion of gram-negative and gram-positive, gas-producing bacilli. This undoubtedly explains why ulcer of the stomach did not develop. In the pulpless teeth of four dogs, the streptococci were still present in pure culture and were injected intravenously into rabbits to test the infecting power of the organisms. Five rabbits were injected with cultures from one dog. The findings were negative, demonstrating that the streptococcus had lost its specificity in this dog. Eleven rabbits were injected with cultures from the remaining three dogs. Seven developed ulcer. Two of the dogs had the small pulp canals previously referred to. The existing infection was evidently not severe enough to

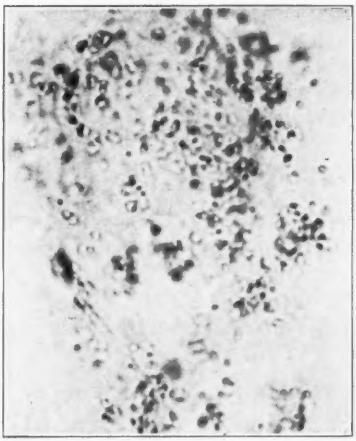


Fig. 9.—Diplococci with areas of cellular infiltration in granuloma shown in Figure 8.

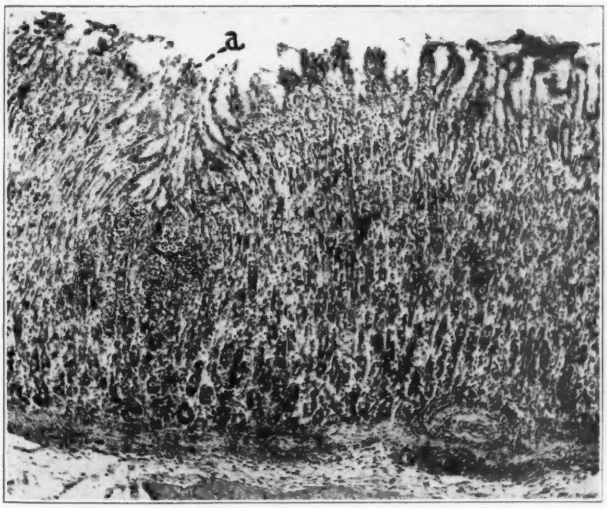


Fig. 10.—Section of a lesion in the stomach of a rabbit several days after intravenous injection of an ulcer strain having long residence in the devitalized tooth of a dog that developed ulcer. The leukocytic and round-cell infiltration between tubules, in the submucosa and surrounding a blood vessel, and beginning thrombosis of the vessels in the submucosa may be noted.

overcome the high resistance of these three dogs during the nine months they harbored the four infected teeth.

Diseases of the urinary tract were also produced in dogs by devitalizing and infecting their teeth with bacteria from foci of patients with nephritis and nephrolithiasis. The results have been published previously,[7] and therefore will only be mentioned briefly. That there is a relationship between dental infections and nephritis is clearly demonstrated by the results in the animals injected intravenously (Table 2). Chronic foci, with bacteria from patients with nephritis, were therefore produced in only six dogs. Five of the six dogs (85 per cent) developed nephritis. None developed lesions outside the urinary tract. One case was of special interest. From the infected tonsils and left antrum of a patient with chronic nephritis, a staphylococcus was isolated that produced nephritis in thirty of thirty-two rabbits injected intravenously. The organism was then introduced into the pulp chambers of two lower cuspids of each of four dogs, which were allowed to live for several months. At necropsy, all four dogs were found to have nephritis, and granulomas at the apices of the devitalized teeth. The staphylococcus recovered from the lesions in the kidney and from the infected teeth, when reinjected intravenously into rabbits, again produced nephritis. The organism was then injected into the peritoneal cavity of several guinea-pigs. After several days, it was recovered from abscesses in the peritoneal cavity and reinjected in large doses into rabbits. Nephritis did not develop. The staphylococcus in this case showed a marked specificity for renal tissue, which it retained during the several months it was in the pulp chambers and periapical abscesses of dogs' teeth, but lost in the peritoneal abscess of the guinea-pig. A detailed report of these experiments has been published in collaboration with Rosenow.

The hypothesis of the bacterial origin of nephrolithiasis was advanced in 1918 by C. H. Mayo.[10] The disease, however, was never experimentally reproduced in animals by the injection of bacteria, and this theory was not generally accepted. That nephrolithiasis might be experimentally reproduced by the production of chronic foci in animals was also suggested by the results of certain other experiments in which animals were in-

Fig 11.—Streptococci in the sloughing tissues at *a* in Figure 7.

fected over a long period of time. Rosenow and I have had an opportunity to study nine patients with nephrolithiasis. Of thirty-four dogs in whom several cuspids were infected with streptococci from the teeth, tonsils or urine of patients, 75 per cent developed calculi. Lesions in the kidney or calculi developed in 87 per cent of the animals infected (Table 2).

The calculi produced in dogs were similar in physical properties and chemical composition to those in the patient. The larger stones were visible in roentgenograms taken at necropsy, although

10. Mayo, C. H.: Problems of Infection. Minnesota Med. 1: 414-416 (Nov. 1918).

TABLE 2.—LESIONS IN DOGS FOLLOWING DEVITALIZATION AND INFECTION OF TEETH WITH BACTERIA ISOLATED FROM DENTAL AND OTHER FOCI

Disease	Strains, 20	Dogs with chronic foci, 73	Percentage Incidence of Lesions								
			Calculi	Renal	Urinary bladder	Urinary tract	Stomach: Hemorrhage	Stomach: Beginning ulceration	Joints	Muscles	Nerves
Gastric ulcer	3	20					65	45			
Nephritis	2	6	17	68	34	85					
Nephrolithiasis	9	34	75	12		87					
Alkaline phosphatic cystitis	2	5	60	20	80	100					
Chronic arthritis	4	8									

they had not been visible at the time the teeth were devitalized and infected. The streptococcus inoculated into the teeth of dogs was recovered at necropsy from lesions in the kidney, from some of the stones, and from granulomas and pulp canals of the devitalized teeth, and its elective affinity for the urinary tract of rabbits was demonstrated by intravenous injection. In some of the teeth, a secondary invasion of gram-negative bacilli had taken place, but the inoculated streptococcus usually predominated. Roentgenograms of the dogs' jaws revealed large rarefied areas around the apices of the pulpless teeth. In ten of the thirty-four dogs experimented on, three cuspids were infected and a fourth was devitalized and filled in a sterile manner with guttapercha points. This tooth became secondarily infected in each of the ten dogs and was found to harbor the same type of organisms as the three cuspids primarily infected.

Only two patients with alkaline phosphatic cystitis were studied. With bacteria isolated from the infected teeth of these two patients, chronic foci were produced in five dogs by devitalizing and infecting several teeth. Although none of the dogs developed typical alkaline phosphatic cystitis, all developed lesions in the urinary tract. Four of the five had hemorrhagic lesions in the urinary bladder, and three of the five had urinary calculi. No lesions occurred outside the urinary tract. In each of the five dogs, one tooth was devitalized and filled in a sterile manner with guttapercha points. At necropsy, this tooth was found to harbor the same type of organisms as the infected teeth.

Chronic foci were experimentally produced in eight dogs by infecting the cuspids with streptococci isolated from four patients with chronic arthritis. None of the dogs developed arthritis. Rabbits injected intravenously with the some strains of streptococci developed arthritis. At necropsy, the injected organisms were recovered from the infected teeth in each dog and reinjected intravenously into rabbits. Again, the rabbits developed arthritis.

SUMMARY AND COMMENT

That the bacteria within the dental foci of the many patients studied had an elective affinity for organs and tissues similar to those in the patients is demonstrated by the results in rabbits following intravenous injection, and in dogs following the production of chronic dental foci. Consistent results were obtained over a period of several years in a large number of experiments. The patients were all carefully studied, from

the clinical standpoint, by expert diagnosticians in the various departments of the Mayo Clinic. That major surgical procedures alone often failed to cure chronic disease, when dental and other foci still exist, is emphasized by the recurrence of gastric ulcer after gastroenterostomy has been performed. The importance of removing every pulpless tooth in patients with chronic diseases of streptococcic origin cannot be overemphasized. In a great many cases in which the roentgenogram showed evidence of infection in some of the pulpless teeth, and not in others, the teeth showing evidence of infection were first removed and organisms from the cultures injected into animals. If the animals developed lesions in organs or tissues similar to those affected in the patient, the remaining pulpless teeth, which were apparently negative in the roentgenogram, were extracted and cultured, and they also were found to harbor the same type of bacteria, having the same elective affinity for the tissues of animals. The amount of bone that may have been destroyed around the apex of a tooth, as revealed in the roentgenogram, in no way indicates the relationship between the patient's disease and the tooth in question. Although roentgenograms reveal evidence of bone changes, they do not reveal bacteria.

That the experimental production of disease in animals is not dependent on the injection of overwhelming numbers of bacteria is demonstrated by the results in dogs following the production of chronic dental foci. None of the dogs harbored more than four infected teeth, but the chronic foci experimentally produced were similar to those in patients. In many of the devitalized teeth granulomas developed, the histopathology of which was similar to that of the granulomas removed from patients. By this method of infecting animals, which furnishes a continuous supply of bacteria over a long period of time, the relationship between nephrolithiasis and infection was demonstrated.

The negative results in dogs whose cuspids were devitalized and infected with streptococci from the infected teeth of patients with arthritis are of special interest. These same strains, at the time they were isolated from the patient's foci, produced arthritis in rabbits, on intravenous injection. About a year later, when they were recovered from the infected teeth of dogs, they again produced arthritis in rabbits, on intravenous injection. The organisms, therefore, retained their specificity for joint tissue while in the teeth of dogs, but failed to produce arthritis either because this species of animal is very resistant to this disease, or because the experiment was too short. A similar condition is often found in patients who have had infected teeth for years before developing arthritis, or other systemic disease of streptococcic origin. This fact is emphasized by Price,[11] who says, "Dental infections, while potentially harmful, may not be causing apparent or serious injury until the individual is subjected to some other overload, at which time a serious break may come."

It is frequently urged that a few streptococci at the apex of a pulpless tooth can be of little significance, because such organisms are always present in large numbers on the oral mucous membrane of all healthy persons. In previous reports, it has been shown that the infecting power of streptococci which multiply and exist in the anaerobic environment around the apex of a pulpless tooth is different from that of streptococci isolated from the mucous membrane of the mouth. Animals injected intravenously with streptococci from the infected teeth usually developed lesions similar to those of the patients; while animals injected intravenously

11. Price, W. A.: I. Dental Infections. Oral and Systemic. II. Dental Infections and the Degenerative Diseases. Cleveland, The Penton Publishing Co., 1923.

with equally large doses of streptococci from saliva or mucous membrane failed to develop lesions. The case of nephritis (reported here) is of special interest because it demonstrates how environment influences the specificity of micro-organisms. The bacteria, when isolated from the focus of the patient, had a marked affinity for renal tissue, which it retained for many months in the teeth of dogs but entirely lost in the peritoneal abscess of the guinea-pig.

That teeth devitalized and filled in a sterile manner often become secondarily infected through the blood stream is demonstrated by the results in dogs in which three cuspids were infected, while in a fourth, the root-canal was filled in a sterile manner. Not only did the cuspids, which were devitalized and filled, become secondarily infected, but they were found to harbor the same type of organisms that were introduced into the three cuspids of each dog at operation.

That a secondary infection of pulpless teeth also occurs in human beings is suggested by the fact that cultures made from several infected teeth in the same mouth (even though the teeth were root-filled by different men at different times) often yielded one type of organism that had the same elective affinity for organs and tissues of animals.

Dental infections are often but one of other contributing foci in patients with chronic progressive diseases of streptococcic origin. If such patients are to be benefited, every possible focus should be eradicated, which can only be done through close cooperation between physician and dentist. In the early case, the prognosis is generally favorable, provided all foci are removed; while, in the advanced case, all that can be hoped for is to check the progress of the disease. The removal of infected teeth will prevent reinfection from that source, but can have little effect on a joint in which articulating cartilage has been destroyed, or on a kidney whose pelvis is filled with calculi.

In view of the results of these various experiments, which corroborate Rosenow's work on elective localization, there can be no doubt of the casual relationship between dental foci and certain systemic diseases. The results strongly emphasize the importance of preventive dentistry.

RELATIONSHIP OF DIET TO MOUTH CLEANLINESS*

By MARION R. STEVENS, B.A., D.D.S., St. Paul, Minnesota

(Read before the American Dental Association, Dallas, Texas, November 10-14, 1924)

THREE years ago, a physician who for more than twenty years had supervised in general the medical needs of the children in the Protestant Orphan Asylum of St. Paul felt that there was need for someone to supervise and be responsible for the dental care of the children. Not that this was the first occasion in twenty years that he greatly felt the need of dental assistance, but at this particular time there was an epidemic of diphtheria among the children, which the institution was having considerable difficulty in clearing up. The physician, knowing the unhealthy condition of most of the children's mouths, believed that this might be partly responsible for the situation. For some time previous, he had tried to cope with the serious dental situation, but because the institution had no funds to pay for either medical or dental care, it was a problem to find someone sufficiently interested in children to assume the responsibility of putting the mouths of these fifty children in a healthy condition, and then maintain this condition after once established. The institution had experienced no difficulty, when a child was suffering with toothache, in finding a dentist to do the necessary extracting, but much more than an occasional extraction was necessary if these children were to be given a fair chance as far as their mouths were concerned.

For some time previous, I had been endeavoring to collect certain data relative to children's dentistry. Difficulties were continually arising, which made results very unsatisfactory. After I had consented to assist in the dental care of these children, a review of the situation at the orphanage revealed the possibility of using this group of children for these data and the making of records. The institution consented to give access to the family history and medical record of the children and to assist in whatever way possible.

The children in this orphanage are not for adoption. They are placed here during the period of time their parents are financially unable or for some other reason unfit to care properly for them. The father or mother may be sick, dead or insane; or have deserted the family; or be serving a prison term; or the court may have taken the children away from irresponsible, incompetent parents and placed them in the institution. Thus, it can be imagined that these children come from very unfortunate homes, where little intelligent thought or care has been given to their well-being and proper development. One result of this indifferent home life is shown by the poor physical condition of the children on entering the institution. While not being actually sick and bedridden, they are far below the standard of normal health.

Each child, on being admitted, is examined by the physician, and now by

*Studies under grant of the Research Commission of the American Dental Association, conducted at Protestant Orphan Asylum, St. Paul, Minnesota.

the dentist as well. If this examination reveals physical defects, such as infected tonsils, weak eyes, weak heart, underweight, anemia, carious or abscessed teeth, or any other condition unfavorable to the health of the child, every effort is made to correct these conditions as soon as possible.

Children may be admitted to the institution as early as at 2 years of age and may remain until 15 years of age. The institution was primarily designed to be only a temporary home until the parent's home could be re-established; hence, some of the children may remain a few months or a year or so, but owing to the impossibility of ever reestablishing many of the homes, a large part of these children remain from the time they are admitted as very young children until from 12 to 15 years of age. This opportunity to see the same child over a period of years and living in a practically constant environment offered a very favorable advantage for the making of records and the collection of data relative to children's dentistry. This obviates in a measure the fact, well known, that one of the problems in making an attempt to collect scientific records and data on human individuals is the difficulty of keeping the individuals under observation for any length of time and in a known environment.

When the work for these children was first undertaken three years ago, the oral examination revealed that eight children who had lived in the institution since they were about 2 years of age, and who were at this time between the ages of 10 and 12, had well developed mouths with surprisingly clean teeth, healthy appearing gums and little or no caries. It was found at this time, before any dental supervision had been instituted, that, as part of the regular daily routine, the children were required to brush their teeth four times a day. The mouths of the rest of the children over 5 years of age were for the most part in a deplorable condition as far as cavities and cleanliness were concerned. The records showed that this last group had either been recently admitted or had lived in their own homes until 5 or 6 years of age or older. They had also followed the routine of prophylaxis four times a day, but their teeth and gums were so sore and such masses of food packed in the cavities that their own prophylactic efforts had been of little avail.

The first step in clearing up the mouth conditions was the extraction of all abscessed teeth and roots. In the group of children for whom extractions were necessary, the number of teeth extracted ranged from one tooth to eleven teeth for each child. Some of these mouths were pitiful sights when the extractions were finished, and more pitiful when the results a few years hence were anticipated from the premature loss of so many deciduous teeth. For one boy of 5, it was necessary to extract eight deciduous molars and two cuspids; for another child of 3½, the four upper anterior teeth and four deciduous molars. In some cases, only one, possibly two occluding teeth, remained. How some of these children were going to be able to masticate was hard to imagine and how their jaws and faces were going to develop only time could tell.

In order to watch the development in these cases of premature loss of the deciduous teeth and to observe what change occurred in the relationship of mandible to maxilla, plaster casts were made of these cases. Succeeding casts, after an interval of a few months or a year, have been made of the same cases, the plan being that these succeeding casts form a series to show the successive steps in development. Obviously it will be necessary to continue this series of casts over a long enough period that the data produced may have scientific value. A similar series of casts are being made for cases in which no premature loss of deciduous teeth has occurred. No space maintaining appliance has been used in any of

these cases, the desire being to observe what would actually occur as the result of the premature loss of the deciduous teeth in these cases. So far, the evidence by no means indicates that it need be universally used, or, if used, that it alone would make normal development possible.

To continue the clearing up of the mouth condition of these children after the extractions had been completed, all the carious teeth were filled. No cavity however small, even if in a deciduous tooth to be normally shed within a few months, was left without being properly filled. Each child had a thorough prophylactic treatment and was instructed how to use his toothbrush. The aim was to put each mouth in as healthy condition as possible; to leave no areas of active decay, and to maintain this condition by regular care.

It took a year's time to make the first round of the institution. When the children returned for their second visit, one outstanding fact became apparent; namely, the beautiful condition of cleanliness practically every mouth presented and the small amount of decay that had developed during the year of time that had elapsed.

The contrast between the condition of these children's mouths after a year's absence from the dental office, and that of most children living in private homes after a similar interval, was striking. The usual soft deposits and dull film covering the enamel surface, the inflamed gingival margins and a number of newly developing cavities were not in evidence. Rather, these children presented mouths with highly polished enamel surfaces with very little or no soft deposits, with healthy gingival margins and with but few newly developing cavities.

It was at this stage of the work at the orphanage that I invited, among others, Dr. Thomas B. Hartzell of Minneapolis and Dr. William A. Grey of St. Paul, to see these children and to observe the results of the work that had been done so far. As a result of this visit, Dr. Hartzell and Dr. Grey suggested to the Research Commission of the American Dental Association that the work be continued under the direction and with the cooperation of the Research Commission.

One of the results of the first year's work showed the necessity of a long period of time necessary to collect the data and records. As one progresses in this work, it becomes more and more apparent that any observation covering a short period, such as one, two, three or even four years of a child's development, cannot produce conclusive data. Beginning as early as possible in the deciduous tooth age, these observations must continue through to the eruption of the twenty-eight permanent teeth before it is possible to deduct conclusions scientifically correct. In order to put the work on a scientific basis, a definite plan of procedure was adopted. Five problems in the field of children's dentistry were evolved, and according to approved scientific methods, each was stated in the form of a hypothesis. The data were collected and classified either to prove or to disprove the hypothesis, and, as a final result of the collection and classification of data, the conclusions were formulated to explain the sequence of facts, and to express their relationship.

For the past two years, the work has been carried on and records have been kept relative to the problems decided on; but as a number of years are required to complete the records and make them of real value, any report concerning them other than the one used as a subject for this paper, will be omitted at this time. (The entire outline of the plan of procedure has been previously placed before the Research Commission.)

Relative to the relationship of diet to mouth cleanliness observed at the orphanage, first a brief review of their diet in general will be presented.

Breakfast:

Cooked cereal with milk (no sugar)
Bread, white and graham (without butter)
Whole milk to drink (about 4 per cent butter fat)
Bacon and eggs, rarely
Stewed prunes, often
Fresh fruit (when funds will permit)

A review of their breakfast menus show that many consist merely of cereal, milk and bread.

Dinner or noon meal:

Meat
Potatoes
Gravy
Bread, graham and white (without butter)
One vegetable, usually cooked, occasionally cabbage salad or celery
Dessert, usually pudding, such as rice, cornstarch or bread pudding
Sometimes candy
Occasionally ice cream

Each child has one helping of meat and vegetables, but he has all he wishes of potato and gravy or bread and gravy, and each child eats both white and graham bread.

Supper or evening meal:

Fruit sauce
Bread, white and graham, sparingly buttered
Homemade cakes or cookies without frosting
Rye crisp, served often
Milk or buttermilk (sometimes both)

Milk is served at the morning and the evening meal, and the daily amount consumed averages about 1 quart a day for each child. This is whole milk containing about 4 per cent butter fat. Butter is usually served but once a day, at the evening meal. Butter and fresh fruit are at most seasons of the year so expensive as to be prohibitive, and the reason they are not included in greater abundance in their diet is because of expense rather than a lack of knowledge of their importance and value.

Bread (white and graham) forms the major portion of all three meals. Thus, bread combined with cereals, potatoes, puddings, cakes and candy makes their diet consist largely of carbohydrates. The small amount of fresh fruit, vegetables, butter and eggs included in their diet would indicate that it is greatly lacking in the ideal balance between protein, fats, carbohydrates, mineral elements and vitamins.

The data presented by McCollum, Seccombe and others attribute unclean mouths, faulty tooth structure, as well as faulty bone structure, and caries, to an unbalanced diet, with special emphasis on the harm to be expected from an overbalance in the direction of carbohydrates. As stated before, in spite of the above given dietary, the mouths of these children are clean from the standpoint of film on the teeth or any inflammation of the gingivae, and, in addition, there is little recurrent decay. Accepting, then, as we do, the findings of McCollum, Seccombe and other nutritional workers as to the value and importance of a properly balanced diet, we are justified in looking further than the diet for an explanation of the conditions observed.

The outstanding feature of the institutional life as compared with that of a similar number of children in private homes is the almost perfect discipline, based on a strict adherence to a routine of living, in an atmosphere of happiness. The children arise at a definite hour each morning (6:30 a. m.); they have their meals at the same time each day; they spend a certain amount of time performing assigned duties, such as making beds, sweeping and dusting. They spend a certain number of hours in school; and they have a certain amount of time for play in the open in the morning before school, again at noon, and before supper. After supper, they either have some form of entertainment or play in their play rooms until bedtime—7:30, in the winter and 8:00 o'clock in the summer. The children under 6 have their little kindergarten in the morning, and when they come in from their play after dinner, take their afternoon nap. Each

child must brush his teeth before coming down to breakfast in the morning and after each meal. Each child has a bath twice a week, with a complete change of undergarments. Each child is dressed differently and can take pride in his own clothes. These children are never taken to a movie or vaudeville performance and only very rarely to any outside diverting function. Entertainers often come to the institution or the children get up little entertainments of their own, at which they have most delightful times. Thus, they are spared much of the emotional and nervous strain of many of our growing children. Nothing is allowed to interfere with their routine of sleeping, working, playing and eating. No one scolds or impatiently frets at them. The graceful acceptance of reasonable discipline becomes part of their lives. Many people, without knowing the true conditions, consider children in such an institution as unfortunate victims of circumstances. But this group of children is a group of happy, healthy, well dressed children. Their eyes are bright and they have a smile for everyone.

To prove to ourselves that the life of the children was constantly as pictured here and that preparations were not made for our coming, we have visited the institution unannounced. We have watched the children at their work, at their play, in their school, at their meals. We have been with them at their parties, we have seen them after they have said their prayers and been put to bed, and always we saw the same strict but kind discipline and routine, the same clean and smiling children, happy at whatever they were doing, and with every evidence of love and respect for those who cared for them. We always carried away with us that feeling of contagious happiness.

Many of these children when they are admitted are underweight, nervous, excitable, ill-mannered and unaccustomed to discipline. When they come to the table, they refuse to eat the foods they do not care for. Some will even resort to the familiar table tantrum to gain their ends. But here they soon find that such methods are of little avail. When a new child refuses to eat certain foods, usually milk or vegetables, the first meal, he is urged to eat a very small amount of the vegetable, or to drink just a little milk. The next meal, the urging is repeated and he is required to eat a slightly larger amount, and so on for a couple of days. The new child sees the other children happily eating all their food, and he soon falls in line and eats as the rest of the group do; and there has been no punishment or forced feeding. We hear so much about children who cannot or will not eat certain foods; but here we have a group of fifty children who eat whatever is placed before them without an evident desire to question. One family of four children was brought to the institution, and the mother made a special request that they should not be required to drink milk. She gave as her reason for making the request that both she and the father disliked milk, that the children had inherited the same dislike, and therefore it was useless to try to get them to drink milk. A few weeks later, we watched these same children eating their evening meal. They were smiling as they drank their milk, and all four lifted their cups to be refilled.

The big factor that makes such table discipline possible is the fact that when these children come to the dining room they are always hungry. They never are allowed a lunch of any kind between meals; therefore, after a half day in school and two hours' play in the open, they can hardly wait until their food is given to them. It is an interesting sight to watch the delight with which the children eat their food. Underweight, nervous, timid children, after a few weeks of regular undisturbed routine and this plain diet, will gain in weight; color will come to their pale faces, and, instead of being nervous and

timid, they become self-possessed, confident and trustful.

The mouths of many of these children, when they are admitted, are in such a condition on account of cavities and abscessed teeth that they are unable to masticate their food. On one of our visits to the institution, we watched a little fellow of 6, who had arrived the previous day, trying to eat his evening meal. Sauce and cake had not satisfied his hunger, and he was bravely trying to eat a slice of graham bread. The other children had finished their entire meal and were dismissed from the dining room, and he was still struggling with his first slice of bread. We knew his mouth was in poor condition, but this fact alone did not account for the great length of time he required to eat his evening meal. The superintendent told us that, in his own home, he had been given a lunch whenever he asked for it, and that he spent his time at the table playing with his food. In the institution, he was not allowed to play while eating, so amused himself by gazing around. When he was brought to the dental office, it was necessary to extract eight deciduous molars and to fill large cavities in his first permanent molars. A month later, we watched this same child at the table. With only six year molars for mastication, he was eating rye crisp and celery. Eating was now a serious business with him. He had gained 3 pounds and was a happy, contented child. The obstacle of sore teeth had been removed, and he had learned that he must eat his food at mealtime in a reasonable length of time; that if he did not, no amount of crying or fussing could procure for him a lunch. In order to work this change, the clearing up of the mouth condition was necessary, but equally necessary was the acquiring of proper eating habits.

As to the weight of the children living on this diet, high in carbohydrates, we found that of the forty-two children who had lived in the institution one year or more, twenty-two averaged 4 pounds overweight, ten averaged 2½ underweight, and ten were of standard normal weight.

The improvement that takes place in the children after living in the institution is evidently a combination of factors. They have been taken out of an environment where they had no regular hours for sleep, where they ate whatever happened to be at hand at whatever time they wished; where they were living in an atmosphere of quarreling and disagreement between their parents; where they were in constant fear of punishment from an irate or drunken father, or where they were accustomed to the impatient scolding of a cross, tired, perhaps partially insane mother. Three little children, aged 3, 4 and 7, came from a home where an irresponsible mother was accustomed to leave the little ones alone in the evening while she was out for amusement. The children had conjured up terrible visions of things which happened in the dark, and if anyone spoke to them they shrank and cringed as if in fear of a blow. They were all underweight, pale, nervous and excitable.

Out of such environments, the children are transplanted to an institution where they have regular hours for sleep, for work, for play and for eating; where they have kind, but firm discipline; where the social and work-a-day life of the adult does not affect the child; where the well-being of the child is of paramount importance.

With the life in the institution as a background, it has been possible, after the mouth has been put in a healthy condition and with home prophylaxis four times a day, to feed these children on a high carbohydrate diet, greatly lacking in ideal balance, and to find them with notably clean, healthy mouths and with little newly developing decay. This has been possible not because of the diet, but in spite of the diet, on account of the very favorable conditions under which these children live. The spirit of happy

acceptance of discipline and the strict adherence to a healthful routine has made possible better nutrition and assimilation on this faulty diet.

DISCUSSION

R. C. Bunting, Ann Arbor, Mich.: Studies of this kind are, in the last analysis, the only authentic basis for any particular theory for caries prevention and prevention of mouth diseases. That is, we can experiment with rats and other animals with various diets, and theorize and speculate; but until we are able to take a group of children and make them immune or partially immune from caries through the observance of a particular set of procedures, we cannot say that our data are of any real value.

I hope to present some work that we have done in Ann Arbor on patients that are very seriously affected by caries, from a little different standpoint. We tried every change of diet we knew on a group of patients that were markedly susceptible to caries. We were unable to change the condition even by strict prophylactic care, and a variety of dietary changes. We found, in spite of all we did, that caries continued to appear and the overgrowth of acid-forming organisms in the mouth was exceedingly high. In desperation, we adopted the measures of using the strong antiseptics, namely certain of the anilin dyes which are highly specific for *Bacillus acidophilus*. There were, as a result, certain apparent changes in the mouth that were quite marked. I believe that if a child were raised from infancy on a diet that was adequate, the pathologic disturbances of the mouth would be considerably less than they otherwise would be. But when once high states of infection, whether spirochete or acid forms, or whatever they may be, become established in the mouth, I believe that we will have to use more drastic measures than diet control to eliminate them. What they have done in the experiment at St. Paul is an interesting piece of work, but as Dr. Stevens says, it will take years to prove the true value of any such preventive procedure.

William Hopkinson, Milwaukee, Wis.: It seems to me, in removing foci of infection from the mouth of children, that it was a great factor in placing the mouth in a condition to resist infection. I noticed that in every case in which extractions were made and infected teeth removed, the mouth was placed in a healthy condition without regard to diet. It seems to me this is one of the largest factors. Then, too, another factor is the prophylactic treatment given to the children. That is, they themselves keep the mouth in condition by brushing off the bacteria that adhere to the teeth. I believe mechanical removal of the bacteria is probably the only method we have today to prevent caries. The formation of the teeth and the correct relation of one tooth to the other has something to do with maintaining the hygienic condition in the mouth. The question of development of the teeth, which of course might be hereditary and would come in the changes in the form of the teeth, would be a natural prevention in keeping the teeth in a healthy condition.

M. C. Alcorn, Wichita, Kan.: Last fall, I was dealing in institutional work, and especially in the diet in the reformatory in Massachusetts for women. One of the factors we have noticed in regard to regular routine work and living is that, irrespective of whether the mouth conditions were cleaned up or not, we always get a marked increase in weight on a fairly good diet. Possibly that institution has a diet superior to that of most places because they are able to get many more fresh vegeables and fruits than many institutions throughout the country. People becoming inmates had many infections, especially venereal diseases. Dental work was optional. Sometimes, I tried to compel them to have the dental work done, but if they absolutely refused, there was nothing we could do.

Every one of the women increased noticeably in weight, and we attributed it to the diet. Someone asked me for records in relation to weight. I found that with routine, care and regular hours, they all increased in weight and general health, even though they wouldn't allow the removal of the infected teeth. I found that true in the Massachusetts School for Crippled and Deformed Children. When I went there, they were on a good diet and generally very well nourished. Many never had any dental work done, and yet they increased in weight. Sometimes, it seemed that we were getting no better results by clearing up the noticeable infections in the mouth.

ANNUAL REPORT OF THE CHAIRMAN OF THE SCIENTIFIC FOUNDATION AND RESEARCH COMMISSION TO THE HOUSE OF DELEGATES OF THE AMERICAN DENTAL ASSOCIATION

(Read before the American Dental Association, Dallas, Texas, Nov. 10-14, 1924)

FOR a detailed report of the activities of the various units of research work, we refer you to the report of the secretary-treasurer,[1] a copy of which has been sent to each member of the Commission and officers of the American Dental Association, and will be published in the Transactions of the Association. However, this report does not cover all the activities of the executive board of the Commission.

The executive board has held two special meetings since the last annual meeting, one in January and one in June. In addition to attending the meetings, each member of the board has given additional time to visiting the various research activities. This means much time given at a sacrifice by each member of the board.

Thus far, the Commission has only assisted in such researches as lead to the prevention of disease, and also determine to what extent diseased teeth and the surrounding tissues affect the health of the individual. The results of this policy have more than justified the existence of the Commission.

At the present time, it seems that an opportunity is developing whereby a mutually advantageous affiliation with the Bureau of Standards at Washington, D. C., can be made. A committee of the executive board which visited the Bureau has made an encouraging report. Further negotiations are planned and are under way. A committee consisting of Drs. Barber, Brown and Volland has been appointed to confer with the officials of the Bureau and report back to the executive board.

We desire especially to refer to the California Stomatological Research Group and its work. You will find a detailed account of its activities in Dr. Volland's report. The Carnegie Foundation has made an additional grant of $85,000 for this work for the next five years, on condition that the research group further raise $4,000 a year, of which our $1,500 is a small part.

It is gratifying and significant that the Carnegie Foundation has thus officially recognized dental research. It is the first time that such recognition has come to dental research from an outside foundation. The part taken by the Research Commission in recognizing and assisting the California Stomatological Research Groups in their plans and activities played no small part in leading the Carnegie Foundation to look favorably on the combined project.

The work of the Commission has been

1. The report of the secretary-treasurer will be found on page 575.

further recognized by a contribution of $1,400.00 from the medical section of the National Research Council of Washington, D. C., which also passed a resolution of commendation of the work being done by our research commission in Minnesota.

Further, the Department of Agriculture at Washington has officially requested that they be permitted to use some of the published work done under our grant at the University of California.

Time cannot be taken to mention the work under way at all the different units where we have given grants, yet we must mention two others that have done much to bring to the mind of the medical profession and the scientific world the work we are doing. The work done at the University of Minnesota under the advisorship of Dr. Thomas B. Hartzell is so well known that commendation is unnecessary. The other is the work of Dr. Percy R. Howe at the Forsyth Dental Infirmary and Harvard Medical School. The Harvard Medical School has set aside three rooms and given Dr. Howe permission to call on as many of its specialists as he may need to further his work.

Therefore, we want to call your attention to the fact that all the universities are permitting our research workers to make full use of their extensive equipment, as well as of the services of some members of their staff.

Since coming to this meeting, it has been learned that several changes in the organization of the Commission have been proposed. These changes under consideration were fully discussed before the Commission. It was the opinion that the proposed changes would greatly handicap the activities and influence of dental research, and we urgently recommend that no changes be made. Further, we recommend that the Commission be placed in a position where its income will be stable and not open to fluctuation.

We hope each member of the American Dental Association will take time to study the secretary-treasurer's report carefully.

Research workers who have the educational and temperamental qualifications are not easily secured and should not have to labor under a constant fear that their work might have to cease at the close of a specified period because of a change in the personnel of the board, or for any other cause than a completion of their problem.

Respectfully submitted,

F. O. Hetrick, *Chairman.*

ANNUAL REPORT OF THE SECRETARY-TREASURER OF THE SCIENTIFIC FOUNDATION AND RESEARCH COMMISSION OF THE AMERICAN DENTAL ASSOCIATION FROM JULY 1, 1923, TO JUNE 30, 1924

(Read before the American Dental Association, Dallas, Texas, Nov. 10-14, 1924)

To the Scientific Foundation and Research Commission:

GENTLEMEN:

DURING the last fiscal year, a larger amount of research work has been supported or assisted by this commission than during any previous year of its existence. At the last annual meeting of the Commission, thirteen grants were approved. The location and amount of each grant is as follows:

1	University of California	$ 2,000.00
2.	Creighton University	1,000.00
3.	University of Louisville	1,500.00
4.	University of Michigan	1,800.00
5.	University of Minnesota	4,200.00
6.	Northwestern University	2,400.00
7.	Forsyth Dental Infirmary and Harvard University	4,000.00
8.	California Stomatological Research Group	1,500.00
9.	West Texas Dental Society	1,000.00
10.	Dental Index Bureau	3,000.00
11.	Nebraska State Hospital, Hastings[1]	500.00
12.	Chicago College of Dental Surgery[2]	2,400.00
13.	Henry C. Ferris[3]	1,000.00
	Total	$26,300.00

1. Through some misunderstanding, Dr. Thomas, the advisor of this grant, did not know that this money had been available during the year, although soon after the last annual meeting he was notified that the grant was made and a method of drawing the funds was outlined to him.

2. No research along the lines for which this grant was asked could be carried on in the Chicago College of Dental Surgery because suitable workers did not seem available.

3. Dr. Ferris reported that he was unable to secure the services of a technician to assist in the work for which he asked this grant.

A condensed statement of the work being done under each grant is as follows:

1. University of California.—The personnel consists of Guy S. Millberry, advisor, J. A. Marshall,* a technician* and a laboratory assistant.*

The investigation covers:

(*a*) A study of the alterations in dental tissues resulting from the malnutritional disorders.

(*b*) A study of the action of the "buffer" substances in saliva and their relation to dental caries and erosion.

(*c*) The therapeutic action of solutions of radium salts.

(*d*) A study of dental erosion.

The progress report on the foregoing follows:

(*a*) This, a continuation of the work reported to the American Dental Association last year, is rapidly reaching the point where some definite statements can be made. The work has been carried on in conjunction with other studies under the supervision of Dr. Herbert Evans, professor of anatomy, University of California.

In carrying out this experimentation, we feel that we are utilizing the facilities of the American Dental Association, as well as of the University of California, to the greatest possible degree, with the minimum waste of equipment, animals, food and space. Most of the expense of this experimentation is borne by the university, and a large technical force is necessary properly to weigh the animals, feed them and keep them clean. This is done at no expense to the American Dental Association.

(*b*) The study on saliva has been of an intermittent nature, dependent on the receiving of typical cases from the clinic and from private practice. This work has now reached the point where it is advisable to concentrate on one or two particular phases, and for this an

*Workers starred are the only ones receiving pay from the commission. Vouchers are made payable direct to them.

additional fund has been asked to pay for an assistant.

(*c*) In the study on the therapeutic action of solutions of radium salts, difficulties have been experienced in the past in securing radium for the continuation of this work. It is believed that this difficulty has been solved, and we will continue the work on a larger scale than before.

I am having constructed at the present time, in the department of physics, an electroscope for the measurement of the strength of the solution used. Up to this time, the work has been entirely empiric in character, and we wish to determine accurate dosage.

(d) The question of erosion interests the profession tremendously, and we feel that concentration on this problem will be very beneficial to the dental profession. It is readily understood that the intermittent manner in which these cases are presented both in clinic and private practice interferes somewhat with the sequence of the investigation but with additional assistant workers more work can be done on the problem (Marshall).

Publications and discussions: 1. Publications.

(*a*) Radium Therapy in Periapical Infections (J. A. D. A., December, 1922).

(*b*) Some Biological Aspects of Orthodontia, (Pacific Dent. Gaz., December, 1923).

(c) The Effects of Nutritional Disturbances Upon Calcification and Decalcification of Teeth in Experimental Animals. A Progress Report.

2. Discussions.

(*a*) The Midwinter Clinic, University of California, January, 1924.

(b) Pacific Coast Society of Orthodontists, San Francisco, February, 1924.

(*c*) San Joaquin Valley District Dental Society, Fresno, California, April, 1924.

(*d*) The California State Dental Association, May, 1924.

It is not only gratifying to Dr. Marshall but to the commission that Miriam Birdseye, nutrition extension agent of the United States Department of Agriculture, has requested the use of certain illustrations that appeared in Dr. Marshall's article published in THE JOURNAL, January, 1924. These illustrations are to be used in certain public work of this department. The following is an excerpt from the request: "We would, of course, expect to give full credit to the laboratory in which work was done and if desired, to the publication in which the illustrations appear." In acceding to the request, Dr. Marshall replied in part as follows: "I shall be very glad, of course, to comply with the request and would appreciate having the research laboratory of the College of Dentistry as well as THE JOURNAL OF THE AMERICAN DENTAL ASSOCIATION given due credit. I ask this for the reason that both the Board of Research of the University of California and the Research Commission of the American Dental Association have jointly contributed funds to the maintenance of this work, and further, since the results of the research appeared in the official organ of the American Dental Association, I am sure the board of editors would appreciate due acknowledgment as well."

2. Creighton University—The Advisory Committee consists of E. H. Bruening, C. E. Woodbury and J. S. Foote.*

The scope of the investigation is covered in a letter from Dr. Bruening:

"After a year of illness, the doctor (J. S. Foote) again took up his work the first of October, 1923. Since that time, he has been constantly at work dissecting, preparing specimens, making drawings, writing up his findings and studying everything he can find that has been published on the subject of development, particularly of the teeth. His entire time and attention is devoted to this research work. He has completed the fish series that represents the various levels of earliest development of teeth. These begin with one of the *Arthopoda*, the lobster, and was carried through nine individuals as follows:

1. A study of the teeth and shell of the claw of the invertebrate lobster *Homarus americanus*.
2. A study of the teeth and bone of a small shark *Mustelus canis*.
3. A study of the teeth and bone of the tenpounder *Elops saurus*.
4. A study of the teeth and bone of the bowfin *Amia calva*.
5. A study of the teeth and bone of the sunfish *Lepomis pallidus*.
6. A study of the teeth and bone of the lake trout *Salmo ferox*.
7. A study of the teeth and bone of the garpike *Lepidosteus*.
8. A study of the teeth and bone of the catfish *Siuridae*.
9. A study of the teeth and bone of the mascalonge *Esox*.

His findings agree with the geologic classification of the American Museum of Natural History, by Dr. William K. Gregory and his associates. They are very much interested in Dr. Foote's work, as is also the Smithsonian Institution in Washington. Copies of his articles have been sent to each institution.

The study of amphibians is now under way. The study of the bull frog has been completed. The American toad is now being studied. The frog has teeth and the toad is edentulous. Why?

This work will be valuable for all time to come, especially to those who take up a study of the changes that occur in the hard tissues of the body (the teeth and bone) through the ages or periods in the evolution of animal life on the earth. Doctor Foote is demonstrating that these changes occur and when they take place.

Doctor Foote believes the teeth of men can be much improved if a standard of calcium content in blood serum can be determined and maintained in the body of the mother during the gestation period, more particularly during the fourth and fifth months of pregnancy."

3. University of Louisville.—The personnel consists of H. B. Tileston, advisor; Theodore B. Beust,* J. I. Essig and A. E. Lang.

The investigation covers:

(*a*) Histology of enamel.
(*b*) Development of enamel.
(*c*) Metabolism of enamel.
(*d*) Comparative dental histology.
(*e*) Brown stain of enamel.

Some attention was also given the oral micro-organisms and the etiology of caries.

Efforts are being made to perfect the common methods of preparing hard sections of teeth. Apparatus constructed for this purpose has already reduced the labor materially.

Invitation is extended to co-workers along these lines to spend several days or weeks in this laboratory (Tileston).

Publications and discussions:

(*a*) Is a Pulpless Tooth a Dead Tooth? (Dent. Cosmos, October, 1923. Read before the annual meeting of the Kentucky State Dental Society.)
(*b*) The Value of Elective Localization Phenomena as Evidence of a Relationship Between Dental Infections Foci and Systemic. (J.A.D.A., June, 1923.)
(*c*) Physiologic Changes in the Structure of the Enamel After Tooth Eruption (J.A.D.A., May, 1924, Read before the American Dental Association, Cleveland, Ohio, September, 1923.)
(*d*) Remarks on Stratification of the Enamel. (Dent. Cosmos, June, 1924).

Three further contributions are nearing completion:

(*a*) A Contribution to the Etiology of Mottled Enamel.
(*b*) Report of Research Work on the Enamel Capillaries.
(*c*) Experiences in Staining Enamel.

4. University of Michigan.—The advisory committee consists of M. L. Ward, C. H. Lyons, R. W. Bunting, U. G. Rickert, and Faith Palmerlee.*

The investigation covers the following:

(1) By R. W. Bunting and Faith Palmerlee:
  (*a*) The relative frequency of *Bacillus acidophilus* in beginning caries and in immune mouths.
  (*b*) The types of *B. acidophilus* isolated and a classification of them according to morphology, fermentation tests and agglutinin reactions.
  (*c*) The production of artificial caries in pure cultures of various strains of *B. acidophilus*.
  (*d*) Methods by which the abundant growth of *B. acidophilus* in mouths undergoing extremely rapid caries could be diminished.
(2) By U. G. Rickert and Faith Palmerlee:
  (*a*) A study by various methods for the determination of how often the apices of pulpless teeth are infected.
  (*b*) How often specific localization can be demonstrated in case of apical infection.

Publications: (*a*) A Comparative Study of the Total Salivary and Blood Calcium in Varying Types of Individuals with Special Reference to Cases of Pregnancy.
(*b*) Focal Infections (Rickert-Palmerlee; Journal American Dental Association, September, 1924).

5. University of Minnesota.—The personnel consists of T. B. Hartzell, advisor; W. P. Larson,* E. T. Bell,* H. O. Halverson,* Mrs. A. R. Brogman* and Marion Stevens.*

The investigation covers:

(*a*) Effect of surface tension on bacterial toxins.
(*b*) Immunizing man to various bacterial poisons. This is an attempt to utilize the finding of (*a*).
(*c*) Laboratory test for tuberculosis. This is a collateral field that appeared during the work on (*a*) and (*b*).
(*d*) Decalcification of teeth by substances other than acids.
(*e*) Sources of infection of nephritis.
(*f*) Primary hypertension.
(*g*) Effect of diet and hygiene on the teeth and associated structures in the mouth of children in St. Paul's orphanage.

Dr. Larson, professor of bacteriology, University of Minnesota, and his assistants have charge of the work under the headings (*a*), (*b*), (*c*) and (*d*).

Dr. Bell, professor of pathology, University of Minnesota, and his assistants have charge of the work under the headings (*e*) and (*f*).

Dr. Marion Stevens, specializing in children's dentistry, has charge of the work under the heading (*g*).

The following is a condensed statement of the plan of work being followed by Dr. Stevens:

1. Relationship of diet to decay.
2. Prophylactic condition; soft deposits and character of saliva relative to amount of decay.
3. Amount of recurrent decay after mouth is put in healthy condition with regulated diet and proper prophylaxis.
4. Medical history of children compared with dental history.
5. Results of early extraction of deciduous teeth.
   (*a*) Loss of space.
   (*b*) Bone development; plaster casts to be made at regular intervals for records.
   (*c*) Early eruption of permanent teeth due to early loss of deciduous teeth. Amount of decay in prematurely erupted permanent teeth.
   (*d*) Physical condition of children deprived early of masticating apparatus.
   (*e*) Mental condition and development in cases of such early loss.
   (*f*) Development of muscles of the bones of the head in cases of early loss or disuse of the deciduous teeth.
6. Results of the treatment of devitalized and putrescent deciduous teeth.
7. Results of preventive treatment of first permanent molars; use of silver nitrate and keeping grooves filled with copper cement.
8. Relation of mouth condition to general health.
   (*a*) Condition before treatment when there is evident systemic infection.
   (*b*) Condition after mouth is put in healthy condition.

Publications and discussions: (*a*) The Effect of Wetting on the Pathogenicity of the Tubercle Bacillus (Proc. Soc. Exper. Biol. & Med., 20: 339).

(*b*) The Mechanisms of Serum Fastness (Proc. Soc. Exper. Biol. & Med. 20: 133).

(*c*) Changes in the Surface Tension of Broth Produced by the Growth of Bacteria (Proc. Soc. Exper. Biol. & Med. 21: 133).

(*d*) The Effect of the Surface Tension of the Medium upon Bacterial Toxins (Proc. Soc. Exper. Biol. & Med. 21: 278).

(*e*) Studies on Quantative Determination of Fat in Micro-Organisms (Proc. Soc. Exper. Biol. & Med., 20: 512).

(*f*) Some Observations on Pellicle Formation (Proc. Soc. Exper. Biol. & Med. 20: 513).

(*g*) The Problem of Wetting and Its Importance in Bacteriology (J.A.D.A., 11: 327).

(*h*) Studies on Decalcification of Teeth (J.A.D.A., to be published).

6. Northwestern University Dental School (Division A).—The personnel consists of A. D. Black, advisor; E. H. Hatton,* Emil Mueller and Miss McMurrough.

The investigation covers:

(a) Studies of investing tissues of teeth, particularly of the periapical region of pulpless teeth. Research work proceeds slowly and attainment of definite, usable results requires time. The analysis and study of material collected in 1921 and 1922 was, therefore, only ready for presentation last year. It is our opinion that many investigators are too hasty in reporting the results of their work before enough data have been collected, or until they have been fully checked and analyzed and their significance understood.

(*b*) Studies on saliva.—The comparative chemical examinations of saliva and blood are going forward in a way which it is hoped will add to our conception of the relationship of salivary composition and its relationship to dental disease, particularly with reference to the lime content of the saliva.

The laboratory is now equipped with a very complete outfit including a hydrogen-ion apparatus for the determination of the reaction of the saliva, a colorimeter, a polariscope and a complete chemical outfit including a very satisfactory centrifuge. This special equipment represents an investment of $1,000.

A very desirable relationship has been established with the prenatal clinic at Michael Reese Hospital, in addition to other connections of Northwestern. Some very definite reports should be ready for publication by the end of the intensive work that is to be carried on.

The progress of this work has been materially increased by the assistance of Dr. Emil Mueller and Miss McMurrough (Hatton).

Publications and discussions: (*a*) Preliminary Report on Comparative Analysis of Blood and Saliva (Research Section of A. D. A., Cleveland, September, 1923).

(*b*) Relationship of Bone Changes in Periapical Infection to Diagnosis and Treatment (Oral Surgery Section of A. D. A., Cleveland, September, 1923). (Both of these manuscripts are entered for publication in the J.A.D.A.)

(*c*) Diet and Teeth. Calcium Metabolism, etc., in Blood, Saliva and Foods (St.

Clair District Society, Illinois, October, 1923).

(*d*) Changes About the Roots of Filled and Treated Teeth and Their Relationship to Systemic Infection (Sheboygan County, Wis., Dental and Medical Societies, November, 1923).

(*e*) Recent Studies in the Pathology of Pyorrhea (Chicago Dental Society, December, 1923; Bull. Chicago Dent. Soc.; right for later publication reserved).

(*f*) The Treatment of Pyorrhea as Related to Its Pathology (St. Paul District Society, Minnesota, January, 1924).

(*g*) Demonstration Clinic—Bone Changes in Pyorrhea and After Extraction (Chicago Dental Society, January, 1924).

(*h*) Pulpless Teeth and Their Relationship to Systemic Disease (Champaign District Dental Society, Danville, Ill., February, 1924).

(*i*) Bone Changes in Dental Disease (Mineral Metabolism) (Kenwood Branch Chicago Dental Society, March, 1924).

(*j*) Bone Changes in Dental Disease and After Extraction (Illinois Dental Society, May, 1924).

(*k*) Periapical Infection Relationship to Pulpless Teeth and Systemic Infection (Pennsylvania State Dental Society, Pittsburgh, May, 1924).

Northwestern University Dental School. (Division B).—The personnel consists of A. D. Black, advisor; William G. Skillen* and a technician.

According to a statement by Dr. Skillen the investigation covers the following: Over five hundred teeth with treated pulp canals have been sectioned and examined, a very laborious and time-consuming process. A very determined effort has been made to relate these to clinical histories and roentgenographic findings. A report on these findings and the conclusions derived from them should be ready some time this fall. A competent histologic technician has facilitated the preparation of the large number of specimens.

Related Work: A very unusual specimen of pericementitis in a dog has been discovered in one of the specimens prepared in the course of this work. In this work, as in similar lines of investigation, it frequently happens that discoveries of a collateral interest not bearing on the problem at hand are uncovered. This specimen has been described and the report will be offered for publication at an early date.

Publications: (*a*) The Permeability of Enamel in Relation to Stains. (J.A.D.A., 11: 402 (May) 1924).

(*b*) Hard Tissue Changes Noted Within the Canals of Treated Teeth, and Their Possible Significance (J.A.D.A., 11: 350 (April) 1924).

(*c*) The Relationship of Periapical Bone Changes and Pyorrhea to Radiograms (Chicago Dental Society, January, 1924; to be published).

(*d*) Periapical Changes About the Roots of Pulpless Teeth (Illinois State Dental Society, May, 1924; to be published).

7. Forsyth Dental Infirmary and Harvard University Medical School.—The personnel consists of P. R. Howe, advisor; Ruth E. Hatch,* Anna Tucker,* Otto Heinzer* L. K. Daghlion,* Winifred Murphy,* Dora G. Brown,* Katharine Killion* and John Biglow.*

The investigation covers:

(1) Caries. Work on monkeys.

(*a*) Caries in all stages from superficial caries to pulp exposure and often entire pulp destruction is being procured with increasing regularity.

(*b*) Microscopic sections of the carious teeth show this caries apparently to be identical with human caries.

(*c*) It has occurred in the same location in the teeth that it occurs in human teeth.

(d) Caries has not been found according to Miller's theory although this has been quite thoroughly tested. This seems to indicate that we must have another theory of decay, a matter which we are studying.

(2) Periodontoclasia (pyorrhea):

(*a*) Many cases have been produced. This has ranged from gingival redness to complete destruction of the supporting structures of the teeth.

(*b*) Tartar formation is a regular accompaniment.

(*c*) The infection is secondary.

(*d*) Traumatic occlusion is also a sequence of tooth drift.

(3) Irregularity of the teeth.

(*a*) This has followed in long continued cases in which development of the jaw has been interfered with.

(*b*) Narrow jaws have been quite common.

Other lesions that have been thought by some to be of dental origin have been produced, eye troubles, heart changes, kidney diseases, colon ulcer, duodenal ulcers, etc. The diagnoses of these general conditions have been made by the pathologic staff of the Harvard Medical School. These affections have resulted from various diets compounded after

modern diets as compared with the diets of races living on natural foods. These are all major problems. They relate to prenatal and infant feeding as well as that of the adult. They are the result of exact experimentation and not theories. They have aroused the interest of the medical profession and they are cooperating with us.

The Harvard Medical School, after an examination of our work, extended an invitation to us to join forces. All postmortem work and pathologic and histologic examinations of animals are being conducted there, which means their official approval of the work, reports by the best experts in the country and an enormous amount of technical work at no expense to us. An extra grant of $2,500 has been given by the Forsyth trustees to further this work at the Medical School. They have given us three rooms there. Work is well under way and the medical men have expressed much satisfaction with the work as so far carried out.

At the Forsyth Institute all available room has been given us, and new apparatus has been installed and refitting of the laboratories has been done.

The staff in the research work consists of six assistants besides myself, and I devote my entire time to the work. Additional help is furnished as needed.

This research organization constitutes the largest and best equipped plant in the world devoted to dental and related subjects. (Howe)

Papers and discussions: *(a)* Further Studies of the Cause of Dental Diseases, to be published.

(*b*) The Relation of Diet to Dental Disease. (Defensive Diet League, Dent. Summary).

(*c*) Diet and Dental Disease (Georgian State Society, Athens, Ga., also at Agricultural College).

(*d*) Experimental Studies of Effect of Diet on the Teeth, (St. Paul, Minn., State Society).

(*e*) Some Effects of Deficient Diets (Hennepin County Medical Society, Minneapolis, Minn.; Midwinter Clinic on "Diet and Teeth," Atlanta).

(*f*) Diet and the Teeth (North Carolina State Meeting, Raleigh, N. C.).

(*g*) Prevention of Dental Diseases Through the Diet, (Penn. State Meeting, Pittsburgh).

(*h*) Research on the Teeth and Related Problems (Western Penn. Harvard Club, Pittsburgh).

(*i*) A Study of the Diet in Its Relation to the Teeth (West Virginia State Meeting, Huntington, W. Va.).

(*j*) The Diet in Its Relation to Dental Caries (Paper for Australian Dental Congress, sent to Dr. C. N. Johnson).

(*k*) The Diet as Related to the Teeth, (Mercer University, Macon, Ga., Summer Course for Health Workers).

(*l*) Some Experimental Effects of Deficient Diets (Harvard School of Public Health).

(*m*) The Experimental Production of Caries—Pyorrhea, and Irregularities of the Teeth (Mass. School of Technology, Public Health Course).

(*n*) Some Results of Defective Diets (American Association of Public Health).

(*o*) Experimental Studies of Deficient Diets (New England Dietetic Association).

(*p*) Pathology Following Modern Diets as Shown by Animal Experimentation (American Dietetic Association).

(*q*) Further Report of Studies on Dental Diseases (New England Dental Society).

(*r*) Investigation of Effect of Deficient Diets (Reading Dental and Medical Society, Reading, Pa.).

(*s*) Further Experiments on the Effect of Diet on the Teeth (Portland, Maine, Dental Society).

Some have appeared in the JOURNAL OF THE AMERICAN DENTAL ASSOCIATION and society proceedings, journals on dietetics and health subjects and have been quoted in a variety of journals here and abroad.

A paper is under way for the American Dental Association at request of Dr. King, also for the *Medical Journal of Tetany*. Other papers are to follow on the work at the Harvard Medical School.

8. California Stomatological Research Group.—The advisor and chairman is F. V. Simonton.

The investigation covers the following:

Pyorrhea (Periodontoclasia). A composite attack on the problem. The extensive plan of attack and the unusual organization of this research project necessarily requires an extensive report. Since this commission has had no small part in the organization and support of this work it is thought that a rather extensive description should appear on the records of the commission at this time when the plan of organization of the group seems to be crystallized. Therefore, the following is Dr. Simonton's report practically in full to this office:

"Since the funds emanating from the 1923-1924 grant by the Research Commission of the American Dental Association were pooled with other funds from the Carnegie Corporation, the Research Board of the University of California, the California State Dental Association and the Associated Radiograph Laboratories

and utilized in support of the same research, I am reporting on the group activity as a whole.

In order to make the report more intelligible, in view of the rather complex nature of the developments both from the standpoint of financial resources and that of investigation proper, it seems desirable to commence with the time when the work was instituted.

In September, 1921, through the courtesy of Warden James A. Johnston and Dr. L. L. Stanley of San Quentin Prison, the facilities of that institution were made available for carrying out an investigation of the results obtainable in the treatment of pyorrhea (periodontoclasia) by instrumental procedures. The workers at that time were Drs. W. H. Hanford, C. O. Patten, Clayton Westbay and myself. Briefly, this study involved the following:

A block of pyorrhetic tissue, including two teeth and investing structures, was excised and microscopic preparations were made. A zone of pyorrhetic tissue, similar in extent of destruction to this first block, was then sought out, treated for a period of nine months excised and likewise prepared for microscopic examination. A comparative study of the treated and untreated tissues was made and the results of this work were first shown at the meeting of the American Dental Association in Los Angeles, July, 1922. Publications emanating from this work appeared in the *Dental Cosmos*, January, 1923, *The California State Journal of Medicine, July*, 1923, and THE JOURNAL OF THE AMERICAN MEDICAL ASSOCIATION, December, 1923.

Concurrent with the foregoing, qualitative and quantitative studies of the organisms associated with pyorrhetic conditions before, at intervals during and after instrumental treatment, with and without germicides, were made by A. P. Batchelder under the direction of Prof. Ivan C. Hall of the Department of Bacteriology, University of California. This work was presented at the American Medical Association meeting in San Francisco, June, 1923. It has not yet been published. We were planning further to correlate the bacteriologic and clinical data involved and will publish shortly.

In order to undertake a more comprehensive study of the different problems involved in the cause of pyorrhea, the work was now enlarged to include workers in the various allied sciences. The new group included three physicians, two bacteriologists and one chemist, in addition to the original four dentists. None of the personnel received any compensation with the exception of an assistant in bacteriology who was paid $20.00 per month from the treasury of the University of California G. V. Black Club.

Commencing January, 1923, a sum of $100.00 per month was made available to the Group by the research committee of the California State Dental Association. This money emanated from the Associated Radiograph Laboratories through the president, Dr. John D. Millikin. Shortly thereafter, a further grant of $500.00 was received from the California State Dental Association. These additional resources made it possible to provide small compensation for the part time services of a biochemist, physical chemist and bacteriologist.

Recognizing the importance to nutrition of mineral metabolism, the possible bearing thereof on the etiology of pyorrhea, together with its relation to calculus formation, to possible consolidations of tooth substance, and to trophic changes in bone, and having available, furthermore, unique facilities for conducting such an experiment, the following project was gotten under way, under the direction of Prof. Guy W. Clark, of the department of biochemistry of the University of California: first, a study of the mineral metabolism of five adult men under varying dietetic conditions, and, second, a study of the inorganic constituents of human saliva.

In the field of bacteriology, under the direction of Prof. Ivan C. Hall, the following studies were undertaken:

(*a*) The possible relation of calcium precipitating bacteria to pyorrhea alveolaris;
(*b*) The presence and possible rôle of anaerobic bacteria in dental infections;
(*c*) The bacterial flora of feces of men on restricted diets of varying calcium contents.

The results and progress of the foregoing and other work were presented at a meeting of the California State Dental Association, June 13, 1923, as follows:

(*a*) Micro-organisms in Pyorrhea, by I. C. Hall, Ph.D., and A. P. Batchelder.
(*b*) Organisms in Pyorrhea Under the Dark-Field, by T. D. Beckwith, Ph.D.
(*c*) Exhibit of Patients, by W. H. Hanford, D.D.S., and C. Westbay, D.D.S.
(*d*) Instruments, by C. C. Patten, D.D.S.
(*e*) Histopathology, by F. V. Simonton, D.D.S.

Also, at the American Medical Association meeting, June, 1923, papers and discussions were presented as follows:

(*a*) Inorganic Constituents of the Human Saliva, by Guy W. Clark, Ph.D., and John S. Shell, B.S.
(*b*) Bacterial Factor in Pyorrhea, by I. C. Hall, Ph.D., and A. P. Batchelder.

(*c*) The Use of the Dark-Field Microscope, by T. D. Beckwith, Ph.D.

(*d*) A Study of the Diet of Prisoners at San Quentin for a Period of Three Years, by L. L. Stanley, M.D.

(*e*) Histopathology of Pyorrhea, by F. V. Simonton, D.D.S.

(*f*) Mass Reaction of the Micro-Organisms in Saliva, by I. C. Hall, Ph.D.

Publications have been as follows:

(*a*) Results Obtainable Through Instrumental Treatment of Pyorrhea. J.A.M.A., Dec. 15, 1923, F. V. Simonton, D.D.S.

(*b*) Bacterial Factors in Pyorrhea Alveolaris, J.A.M.A., Nov. 17, 1923, I. C. Hall, Ph.D.

Awaiting publication are:

(*a*) The Use of the Dark-Field Microscope in the study of Pyorrhea, by T. D. Beckwith, Ph.D.

(*b*) The Study of the Diet of Prisoners at San Quentin for a Period of Three Years (in Reference to Health and Dental Condition).

In September, 1923, a grant of $1,500.00 was made to this work by the American Dental Association. In October, 1923, a further grant was received from the Carnegie Corporation of $85,000.00, to be expended over the next five years, as follows: $10,000.00, the first year; $15,000.00, the second and third years; $20,000.00, the fourth year, and $25,000.00, the fifth year; with the proviso that $4,000.00 additional be raised each year from other sources.

The Carnegie Corporation appointed a reviewing committee comprising Dr. William C. Ophuls, dean of the Stanford University School of Medicine, Dr. C. B. Lipman, dean of the graduate division of the University of California, and Dr. H. Jerome Allen of Santa Barbara, Calif.

After correspondence with the various institutions involved in the several grants, the funds from various sources were pooled and a budget carrying a total appropriation of $13,876.52 was prepared, Nov. 26, 1923. This sum was apportioned to eight directors of research and thirteen assistants and a small amount was set aside for materials and equipment.

Following are the sources of income:

Associated Radiograph Laboratories	$ 1,200.00
California State Dental Association (bal. 7-1-23)	200.00
U. C. Research Fund, Guy W. Clark	105.00
U. C. Research Fund, F. V. Simonton	360.00
American Dental Association	1,500.00
College of Dentistry, Univ. of California	4,800.00
Carnegie Corporation 67.5 per cent total allowance 1st year	6,750.00
	$14,935.00

In addition to the personnel previously mentioned, Dr. E. V. McCollum of the Johns Hopkins University and Dr. L. B. Mendel of Yale University accepted associate membership in the Group.

The investigations planned under this budget representing either new studies or a continuation of those under way, are as follows:

Biochemistry: A continuation of the work under way, involving the complete mineral analysis of the blood, saliva, foods, feces and urine at regular intervals, of five adult men on varying diets. This experiment, the longest on record, covered a period of twenty-eight weeks. More than 4,000 chemical determinations were necessary, exclusive of duplications and checks. Correlation and interpretation of findings are still under way. We expect the completion of this work about September of this year.

Bacteriology: A continuation of the work under way concerning:

(*a*) Mass reaction changes in saliva and the possible relation thereof to precipitation of calculus.

(*b*) The possible relation of anaerobes to pyorrhea.

(*c*) The possible correlation of the bacteriophage with clinical dental conditions.

(*d*) Further studies of *Micrococcus gasogenous.*

Histopathology: (*a*) An endeavor is being made to reproduce in dogs, rabbits, and guinea-pigs a lesion similar to pyorrhea in man. Injections of fresh pyorrheal exudate are made for this purpose deep into the periodontal membrane. In other animals, irritation is produced by placing foreign and inert finely divided materials in contact with the periodontal membrane. In still a third series, both procedures are being followed at the same site.

(*b*) A series of experiments is under way in dogs, rabbits and guinea-pigs to observe how repair takes place following trauma to the alveolar process, periodontal membrane, cementum and dentin. For the final demonstrations of this series, tissue sections will be prepared.

(*c*) The same project as outlined in (*b*) is being carried on in guinea-pigs rationed without greens in the diet. Does such deficiency alter the possible repair processes?

(*d*) A series of more than 1,000 preparations vitally stained with neutral red for the determination of clasmatocytes in exudate from pyorrheal pockets in man has been carried through. The presence of these cells appears to be coincident with an active inflammatory process. There is no evidence that they play an active part in local immunity here.

(*e*) Sections are out from a series of gingival tissues removed from lesions in man.

These are stained by various technics such as Nicolle's phenol-thionin, Gram-Weigert and Levaditi's silver precipitation for the demonstration of micro-organisms, if present. The usual hematoxylin-eosin is included for additional pathologic study.

The work thus far has shown that the dark-field illuminator is a valuable adjunct for the demonstration of micro-organisms in oral exudates.

Medicine: Studies of pyorrhea and other oral foci of infection in relation to possible systemic sequelae, with the aid of a full-time physician and a part-time bacteriologist, and the cooperation of the staff of the College of Dentistry, University of California and the Medical School, University of California.

Clinical Dentistry: (1) Studies of the possible beneficial influence of certain treatments in conjunction with instrumentation, such as (*a*) calcium lactate and cod liver oil, by mouth; (*b*) endocrine therapy of various kinds; and (*c*) local germicides.

(2) Standardization of roentgen-ray technic for pyorrhea research.

(3) Standardization of mouth examination in reference to pyorrhea.

(4) Studies of racial susceptibility to pyorrhea in Whites, Mexicans, Negroes, Japanese and Chinese.

(5) Studies of traumatic occlusion.

(6) A study is also under way, by correspondence, of dental conditions in various parts of the world—India, China, Alaska, England, Scotland, Greenland, Iceland, Norway, etc.

Protein Chemistry: Studies in this field have been delayed awaiting the appointment of a properly qualified research assistant. This work will be gotten under way, July 1, 1924.

Endocrinology: Research in endocrinology is also awaiting a properly qualified investigator.

The papers now under way are as follows: (Titles given may not be literally followed but indicate the contents of the various papers.)

(1) A study of teeth conditions of 692 Mexicans and 810 whites, (undergoing final revision), by L. L. Stanley, M.D.

(2) The examination of a mouth with special reference to pyorrhea (awaiting completion of illustration), by F. V. Simonton, D.D.S.

(3) Standardized radiographic technic in pyorrhea research, (awaiting completion of mechanical devices), by F. V. Simonton, D.D.S.

(4) Studies of traumatic occlusion, (in course of investigation), by W. C. Fleming, D.D.S.

(5) Qualitative and quantitative study of micro-organisms associated with pyorrhea before, during and after treatment (undergoing final revision), by A. P. Batchelder.

(6) Studies of mineral metabolism in man and inorganic constituents of saliva (to be completed about September, 1924), by Guy W. Clark, Ph.D.

(7) (*a*) *Micrococcus gasogenous,* a minute gram-negative obligate anaerobic organism, of interest because of its failure to produce acidity and its invariable tendency to alkaline formation; by Ivan C. Hall, Ph.D., and assistants.

(*b*) Further studies of mass reaction changes in saliva, by Ivan C. Hall, Ph.D., and assistants.

(*c*) The bacteriophage in human saliva and its possible relation to dental conditions; by Ivan C. Hall, Ph.D., and assistants.

(*d*) Anaerobes of oral flora, by Ivan C. Hall, Ph.D., and assistants.

(8) (*a*) Studies in histopathology of pyorrhetic tissue, by T. D. Beckwith, Ph.D.

(*b*) Microscopic studies of effects of instrumental injuries of dental tissues in dogs, rabbits and guinea-pigs, by T. D. Beckwith, Ph.D.

(*c*) Clasmatocytes in pyorrhea, by T. D. Beckwith, Ph.D. (All to be completed about September, 1924.)

(9) Oral foci of infection in reference to possible systemic sequelae, by F. P. Wisner, M.D., M.A. (to be completed about September, 1924).

(10) Ameba of the mouth, C. A. Kofoid, Sc.D., Ph.D.; (awaiting publication, J.A.D.A.).

The following is the budget for 1924-1925, approved by the group, May 1, 1924.

Estimated Income:

Associated Radiograph Laboratories	$1,200.00
American Dental Association	1,500.00
Other sources	1,300.00
	$4,000.00

Carnegie Corporation:

Balance from pooled funds of 1st annual appropriation	$ 3,250.00
75 per cent of 2nd annual appropriation, less 10 per cent reserve	10,375.00
	$17,625.00

Estimated Expenditures:

Salaries, based on 1923-1924 budget (without change)	$15,900.00
Balance available for expenses	1,725.00
	$17,625.00

9. West Texas Dental Society.—The personnel consists of F. O. Hetrick, advisor, and C. A. Pierle.*

The investigation covers:

Brown Stain. C. A. Pierle, department of chemistry, West Texas State Normal School, Canyon, Texas, with two assistants, is working on some phases of the chemistry of this problem.

P. R. Howe and Theodore Beust are interested in this problem and will do some work when more materials are gathered.

C. K. Wofford, Plainview, Texas, and Fred Dodson, Amarillo, Texas, are assisting in getting the investigation under way.

10. *Dental Index Bureau.*—The personnel consists of A. D. Black, director, E. M. Bebb, Gladys E. Sherman,* Cataloguer, Mrs. Flora B. Mann,* and Mrs. W. P. Warner.*

During the past year steady progress has been made in indexing our periodical literature, and another volume of the Index, covering the ten years. 1876-1885, will be published before the next meeting of the American Dental Association. The cards have all been written and arranged and the copy for the printer is now being typewritten. This volume will contain, as its special feature, an article by Dr. William H. Trueman, of Philadelphia, reviewing the dental literature of England from the time of the first publication up to 1885.

In addition, practically complete files of all journals for the years 1886 to 1910, have been collected and considerable advance work has been done of these, both in classifying articles and in writing cards.

Possibly, it should be stated again that all of this work is being done in the library on the third floor of Dr. Black's private residence in Evanston. The women employed devote their entire attention to this work under most favorable conditions of quiet and without interruption (Black).

11. Nebraska State Hospital for Insane, Hastings, Nebr.—The advisor is E. A. Thomas.

The hospital authorities have provided the services of a dentist who devotes sufficient time to the routine work in the hospital to relieve Dr. Thomas of that responsibility. Dr. Thomas is devoting more time to the study of the caustive factors of nervous disorders that may be attributed to conditions of the dental organs and their associated structures. He has enlisted the services of a technician in the hospital to assist in making studies of the histopathologic development of impacted and unerupted teeth, and their relation to nerve disorders. This technician's services are gratuitous.

Some work is being done in an attempt to study "nervous children" in the public schools. To this end, the superintendent of schools and the school nurse have been interested and are lending their assistance.

Publications: (*a*) A Study of the Causes of Nervous Disorders (Dent. Summary, August, 1924).

Bureau of Standards, Washington D. C.—During the meeting of the executive board in January, 1924, and again in June, 1924, there was considerable discussion concerning various plans looking toward the Research Commission making some sort of a working agreement with the Bureau of Standards at Washington, D. C.

Stated briefly without explanation and arguments, the executive board feels that if the rules under which the Bureau operates will permit, the following could be accomplished:

(*a*) Standards of materials, i.e., golds, cements, etc, for specific purposes, could be set up. Committees from the membership of the American Dental Association could be formed to cooperate in this work.

(*b*) A "checking or reviewing" station could be established in the Bureau to investigate the physical characteristics and chemical composition of materials offered to the profession on the open market and check them against the standards.

It is readily understood that this is a tremendous field and has many factors to be weighed and considered.

To further investigate this matter, a committee composed of H. C. Brown, L. L. Barber and L. Meisburger was named by Chairman Hetrick to go to Washington and interview the director of the Bureau on this subject.

Visits.—At the meeting of the executive board in January, 1924, it was decided that members of the executive board should visit various institutions where work assisted by a grant is being done in order to familiarize themselves with the work being done. Members of the board have often been urged by the advisors and workers to visit the work. These visits were made in a cooperative spirit and it is evident that both parties profited. Chairman Hetrick assigned the visits as follows:

(*a*) Forsyth Dental Infirmary and the work of H. C. Ferris, to be visited by Dr. Meisburger.

(*b*) Northwestern Dental School, Chicago College of Dental Surgery and the University of Louisville, to be visited by Dr. Brown.

(*c*) Michigan University, to be visited by Dr. Barber.

(*d*) Nebraska State Hospital, the Texas Dental Society and Creighton University, Omaha, to be visited by Dr. Hetrick.

(*e*) Minnesota University, to be visited by Dr. Volland.

The secretary-treasurer's books and accounts were checked and audited on June 30, 1924, and an official copy of the audit is in the hands of the chairman. The following is a copy:

Iowa City, Iowa, July 1, 1924.

Dr. R. H. Volland, Treasurer,
Scientific Foundation and Research Commission of the American Dental Association.

Dear Sir:

I herewith submit report of the conditions of your account as treasurer, beginning July 1, 1923, and ending June 30, 1924.

RECEIPTS RESEARCH FUND

July 1, 1923, Balance	$32,164.39
Annual dues	13,272.53
Interest	1,008.47
	$46,445.47

DISBURSEMENTS RESEARCH FUND

Expense	$ 1,936.13
University of Minnesota	3,659.25
Forsyth Dental Infirmary	3,077.49
Chicago College of Dental Surgery	25.00
Dental Index Bureau	2,795.25
Henry C. Ferris	150.00
University of California	2,000.00
University of Michigan	1,800.00
University of Louisville	1,500.00
Creighton University	416.00
West Texas Dental Society	88.87
California Stomatological Research Group	1,500.00
U. S. Bonds	20,294.37
June 30, 1924, Balance	5,002.45
	$46,445.47

MONEY DEPOSITED AS FOLLOWS

The First National Bank of Iowa City, Iowa	$ 824.90
Farmers Loan & Trust Co., Iowa City, Iowa	4,177.55
	$ 5,002.45
U. S. Bonds	$20,294.37

Respectfully submitted,
J. W. GATENS, *Teller,*

First National Bank of Iowa City, Iowa.

Owing to the controversy that has arisen over the rise and apportionment of dues voted on at the Cleveland meeting of the American Dental Association, all money apportioned to research has been held in trust by the Treasurer of the American Dental Association until the controversy is finally settled by the House of Delegates at Dallas. Before the decision to hold all money representing a rise in dues had been made, the Treasurer of the American Dental Association had remitted to the Research Commission the sum of $4,603.52. This was returned to the Treasurer of the American Dental Association by the Research Commission Check No. 725 on July 5, 1924. In the secretary-treasurer's report for the fiscal year 1922-1923, it is noted that the sum of $4,694.00 (A. D. A. checks Nos. 1268, $1,684 and 1275, $3.010.00) representing state society dues for May and June, 1923, were received too late from the Treasurer of the American Dental Association to be included in the financial statement for the year. Therefore, while the foregoing financial statement shows an income from state society dues of $13,272.53, in reality the income of the commission from this source for this fiscal year has been $3,979.01. This amount represents the payment of back dues by members of the American Dental Association.

In order to summarize and bring to your attention quickly the condition of the finances of the commission, the following table and comparisons are made.

	Year 1921-22	Year 1922-23	Year 1923-24
Annual Dues Received by sec'y-treas.	$23,999.10	$23,537.70	$ 3,979.01
Interest received	640.00	823.28	1,008.55
Number of grants	8	10	13
Budget	15,500.00	23,300.00	26,300.00
Budget disbursements	10,544.20	21,094.40	19,212.52
Administration exp.	470.78	444.98	1,936.13

The balance deposited in the Farmers Loan and Trust Company is bearing 4 per cent interest compounded semi-annually. At the end of the fiscal year 1922-23, a balance of $24,963.37 was deposited in the Farmers Loan and Trust Company. With an idea of safeguarding these funds, Liberty Bonds to the amount of $20,294.37 were purchased in the name of the Commission.

Since the working income of the commission was so decidedly decreased during this fiscal year a part of these bonds were sold to meet current budget expenses (See Financial report dated Sept. 25, 1924).

STATEMENT OF GRANTS, JUNE 30, 1924

	Grant	Disbursement
1. University of California	$2,000.00	$2,000.00
2. Creighton University	1,000.00	416.66
3. University of Louisville	1,500.00	1,500.00
4. University of Michigan	1,800.00	1,800.00
5. University of Minnesota	4,200.00	3,659.25
6. Northwestern University	2,400.00	2,200.00
7. Forsyth Dental Infirmary and Harvard University	4,000.00	3,077.49
8. California Stomatological Research Group	1,500.00	1,500.00
9. West Texas Dental Society	1,000.00	88.87
10. Dental Index Bureau	3,000.00	2,795.25
11. Nebraska State Hospital,[4] Hastings	500.00	

4. Nebraska State Hospital has used none of its grant because of a misunderstanding.

	Grant	Disbursement
12. Chicago College of Dental Surgery[5]	2,400.00	25.00
13. Henry C. Ferris[6]	1,000.00	150.00
	$26,300.00	$19,212.52
Unspent Balance of Budget		$7,087.48

In making appropriations for the ensuing year, the commission must bear in mind that its income will be materially decreased. The office of the Secretary of the American Dental Association reported that it was holding only a little more than $18,000.00 for research on Sept. 10, 1924. During the year 1922-1923, the income for research was approximately $25,000.00.

Respectfully submitted,
R. H. VOLLAND,
Secretary-Treasurer.

During the annual meeting of the Research Commission at Dallas in November, 1924, the following grants were approved for the fiscal year 1924-1925.

1. University of California	$ 2,000.00
2. Creighton University	300.00
3. University of Louisville	1,500.00
4. University of Michigan	1,800.00
5. University of Minnesota	4,200.00
6. Northwestern University	2,400.00
7. Forsyth Dental Infirmary	4,000.00
8. California Stomatological Research Group	1,500.00
9. West Texas Dental Society	1,000.00
10. Dental Index Bureau	1,742.00
11. Nebraska State Hospital	500.00
12. Bureau of Standards	600.00
	$21,542.00

The following facts should be noted:

(*a*) No new grants were established.

(*b*) No increase to establish grants were allowed.

(*c*) The budget this year is between $4,000 and $5,000 less than that of the previous fiscal year. This decrease is due to lack of available funds.

F. O. HETRICK, *Chairman,*
R. H. VOLLAND, *Sec'y-Treas.*

5. The expenditure in this grant represents the payment of a small account incurred in 1922-1923.

6. The expenditure in this grant represents the payment of an account incurred in 1922-1923.

DEPARTMENT OF DENTAL HEALTH EDUCATION

DENTAL CLINICS FOR CHILDREN IN INDIANAPOLIS

By PAUL L. KIRBY,* D.D.S., Indianapolis, Indiana

FROM a very feeble beginning less than nine years ago, free dental service for children in Indianapolis has grown until at present it is available for all the schools of the city. From one little station operated one period a week, it has developed until, in January, 1925, there were in operation nine distinct stations, working a total of twenty-two half-day periods each week; and the extension is still in progress.

But this development has not been one of steady growth. The little venture of nine years ago, launched by the Children's Aid Association, a private, or voluntary, child welfare society, and guided by a group of members of the local dental society, under the chairmanship of an Indianapolis dentist, was doomed to founder a few weeks after the start. Then, for about two years, all that remained apparent was a vacant white chair and a neat cabinet filled with shining instruments.

I came to take charge of the Children's Aid Association in 1918, and seeing in the vacant chair and other equipment an opportunity for great service to neglected children if only a staff of dentists could be organized, soon began an endeavor to establish the clinic again. This was not easy to do. The chairman of the committee could see little hope of success, and, in September of that year, resigned. In December, 1918, the project was again under way with a new chairman and a list of twenty-two volunteer practicing dentists, each pledged for service once a month. Not much headway was made, as many of the volunteers found it inconvenient to keep their appointments. In two months, only fifty-three children had been treated, and the list of twenty-two available men had dwindled to four.

The new chairman was released in March, 1919, and without chairman or committee, I, as director of the Children's Aid Association, undertook to hold the small remnant of the staff and to continue the service. That it was possible to keep the project alive at all at this time was in large measure due to the sincere interest and unselfish service of two of my colleagues, Drs. William G. Martz and T. A. Kimberlin.

The spring of 1919 marks the beginning of real free dental work in Indianapolis. The events of the three years preceding are interesting only as history and as they are indicative of the vicissitudes and adventures through which a

*Director, Division of Child Hygiene, Department of Public Health and Charities.

worthy enterprise must sometimes pass before it is established. This enterprise was eventually established, as stated, early in 1919; but there was still at that time only one station, operated two half-days each week.

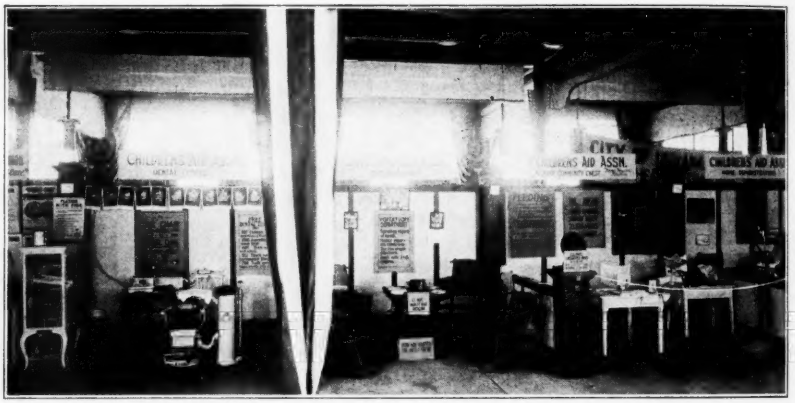
A year later, early in 1920, a second station was opened, at the Jewish Communal Building, and about a year later, 1921, a third was opened, in a public school building.

In June, 1920, the small staff of dentists, working heretofore as volunteers, were put on a pay basis, each man receiving $5 for each three-hour clinic he conducted; and the small remuneration was apparently welcome evidence of appreciation. We had demonstrated that a purely voluntary service, while possible at least for a time, could not prove continuously satisfactory and reliable. The small payment had insured consistent service and regularity on the part of the operators, and a greater sense of loyalty and responsibility on their part.

The city department of health had, as early as 1917, been interested in a survey of the dental condition of school children. This survey was made by a committee of the dental society, and 20,802 pupils were examined, a careful report being drawn up showing malocclusions and gum conditions, and charting 65,400 cavities, 5,000 lost crowns and 1,061 permanent teeth missing.

In 1920, the interest of the department of health was further aroused by the effort of the Children's Aid Association to establish a dental service for children, and it made a grant of $300 toward the operation of the clinics. The next year the department voluntarily increased its grant to $3,000. The following year, the way was opened for the department to take over full support and responsibility for the work.

The Children's Aid Association, mentioned as having initiated and established the free dental clinics, was, as has already been stated, a private child welfare organization, supported by voluntary contributions and having a wide range of interest in work for children. A part of its effort was directed toward



Part of the equipment which was set up as an exhibit and demonstration booth at the Health Exposition.

child health, the dental clinics developing as an aspect of this phase of the work. The baby welfare or baby feeding and "keep well" clinics of the city were also under the direction of this association. In 1922, the Community Chest, which had undertaken the financial support of the Children's Aid Association and other social welfare organizations of the city, strongly urged reorganization and realinement among the social agencies; the Children's Aid Association surrendered a part of its activities to the newly constituted Family Welfare Society, and its health activities naturally became allied with the department of health, I being asked to continue in charge under the new auspices.

Thus, beginning with November, 1922, the dental clinics became a part of the newly created division of child hygiene of the department of health. At this time, there were but three stations, one of these being operated three half-days each week and the others but once a week. Early in 1923, a fourth clinic was opened. This clinic also was operated but once a week. Funds were at that time very low.

Beginning with 1924, gradually the number of days of service at each station was increased, and, during the last two months of the year, five new stations were equipped and opened. These were centrally located with reference to the particular schools from which most of the patients were to come. In this way, it was made possible not only for each school in the city to have its assignments but also to offer each one as many appointments as it could properly fill.

A plan of organization and procedure has been slowly evolved through a study of established dental clinics in other cities, such as Boston, Rochester and Bridgeport, and in conformity with apparent necessities in the local situation.

The staff is composed of graduate practicing dentists of high standing, practically all of whom are men who have not been long out of school, and consequently have not yet built up a practice large enough to demand all their time. Through conference, past experience and custom, a rule of procedure has been built up that assures the desirable degree of uniformity in practice without eliminating individuality and initiative on the part of the operators.

Each operator has his definite weekly assignment or assignments. Each such assignment means to a certain extent a distinct clinic, for it means the same place at the same period each week; it means the same assistant and the same persons bringing in clinic material each week; it means children from the same district, and the same children, returning until their work is completed; it means that one operator does not continue work initiated by another, and that each can finish what he has himself begun.

Several assistants have been trained in the work, and each has her schedule of clinics at which she is to be present. The first duty of the assistant is to be at hand, as in a private office, to facilitate the work of the operator, to anticipate his needs and to have instruments and materials ready. Her other duties are to keep all records and the schedule of appointments for the operator and to keep the equipment and supplies in order.

Each child has his individual record card, made out on his first appearance at the clinic. This shows briefly his family history and situation, and contains a diagram on which all work done is charted under the dentist's direction.

Naturally, one of the problems of the

work was that of getting the children to attend according to a dependable schedule. To leave the matter to their own inclination would obviously not do. Particularly would it be found that their desire to return for a second session would be negligible. Even remaining in the schoolroom to pursue an education might seem more desirable than to go back to the dentist. To have someone whose mission it was to get the child to the clinic seemed necessary. At first all social workers of the city were given the privilege of making appointments for indigent children known by them to have need of dental care. Later, it became apparent that those who could best do this were the school nurses, who are especially charged with school-child health, and who, in the course of their routine, examine all school children and are thus informed as to their physical needs. Moreover these nurses are expected to visit in the home and to know the home surroundings. They are expected to urge corrective treatment and proper care for all physical defects, preferably at the parents' expense in the office of the regular private physician or dentist, if that is possible; and if this is financially impossible, then through an established public clinic. Hence, employment of this corps of about twenty-five school nurses has proved to be the most reliable means of getting the children to the clinics and of assuring that those who come are from families that cannot afford the charges made in a private office.

The scope of the work we have had also to consider. Prophylaxis, extraction and some filling were clearly our duty. Just where to stop, when confronted by the children of the poor, with work to be done by us or not done at all, was not easy to decide. Consequently, we are doing all that is indicated up to the limit of our facilities; nothing requiring laboratory work, but much amalgam and some porcelain filling. We have made special arrangements outside for roentgenography and some crown work; also through a special fund for some orthodontia.

During 1924, 1,172 new children came into the clinics. There were also about 100 carried over from the previous year. All but 120 of the children who came to the clinics during the year were discharged, to return at a future date for reexamination. Among the 120, many were carried over into the year 1925, to have the work finished later. The records show that 2,149 teeth were extracted, and that 2,453 fillings were put in, 1,682 amalgam and 119 porcelain.

These figures are hardly indicative of what we may expect in 1925, as, with the five new clinics opened at the very end of 1924, we have available about three times the service offered last year. The report for January, 1925, shows 272 new children appearing at the clinics, and a total of 800 appointments kept. It records 609 fillings, of which 418 were amalgam and 28 porcelain.

It is probable that, in 1925, we shall discharge, with all indicated work completed, nearly 4,000 children. This will be approximately 10 per cent of the school population and will mean that we shall soon have an opportunity to take up work in the lower grades and among the less extreme cases—among those requiring less time in operative work and those for whom more truly preventive and educational work can be done. For the present, with so many desperate conditions existing, it seems wisest, almost imperative, to schedule first those who are in greatest need.

THE DENTITION OF ITALIAN CHILDREN*

By JOHN C. GEBHART,† New York City

THE chief characteristics which must be noted in judging the physiological development of children are the increase in skeletal growth, as indicated by increment in height, the increase in body weight, bone formation, particularly as indicated in the ossification of the epiphyses and the eruption and shedding of teeth. In the previous section we have presented material which indicates as clearly as may be in studies of this kind skeletal growth and increase in body weight of the particular group under consideration. The observation of the process of ossification was ruled out because of the expense involved in making radiographic examinations. We were able, however, through the dental clinics which we are conducting in the schools of the area to make observations of the order of the shedding of temporary teeth and the eruption of permanent teeth.

We find that there is a dearth of complete and reliable material regarding this important process. Earlier studies have frequently either been confined to the upper or lower teeth; they have often included only one sex and usually they have been confined to one side of the mouth. The present study covers both boys and girls and includes not only upper and lower teeth but both sides of the jaw. We believe, therefore, that the material will have some value in establishing reliable norms for the order of dentition in children.

The most complete study of recent years is that published by Dr. Milo Hellman, to which we shall refer later.[1] Dr. Hellman has kindly assisted in planning the present study. Professor Franz Boas of Columbia University not only assisted in planning the recording of the data but he devised the rather complicated method of computing averages which was necessary in analyzing the material.

HOW THE RECORDS WERE SECURED

In our school dental work, the supervising dentist, Dr. De Lan Kinney, annually makes a rapid examination of the mouths of all the children in school to ascertain which children need corrective dental work. It was a fairly simple matter, therefore, to add to these examinations a record of the presence of particular teeth. This work was undertaken in October, 1922, at which time the shedding of deciduous teeth and the eruption of permanent teeth was recorded for 1,150 boys and 1,200 girls between four and thirteen years of age. Any tooth which had pierced the gum, even though it was not in the line of occlusion, was considered as having erupted. In this series we were able to record the age of the shedding all of the temporary teeth, but because there were so few children over thirteen years of age the second permanent molars (or 12-year

*Reprinted from Publication No. 132 "The Growth and Development of Italian Children in New York City," of the New York Association for Improving the Condition of the Poor; being one of a series of studies that the association has recently published.

†Director, Department of Social Welfare, A. I. C. P.

1. Nutrition, Growth and Dentition. Milo Hellman, D.D.S., Dental Cosmos, January, 1923.

TABLE I—AVERAGE AGE IN YEARS AT WHICH DECIDUOUS TEETH ARE SHED

ITALIAN BOYS

	Right Side		Left Side	
	Average	S. D.	Average	S. D.
Upper Set				
Central Incisor	7.41	1.07	7.48	1.11
Lateral Incisor	8.16	1.28	8.67	1.23
Canine*	11.55	1.64	11.74	1.54
Molar I	9.58	2.24	10.51	1.90
Molar II	10.63	2.21	11.30	1.93
Lower Set				
Central Incisor	6.75	1.17	6.95	.96
Lateral Incisor	7.85	.95	7.89	1.16
Canine	10.86	1.30	11.14	1.54
Molar I	9.93	2.41	11.17	1.68
Molar II	10.10	2.81	11.94	1.58

molars so-called) and the third permanent molars (wisdom teeth) were not recorded.

In the tabulation, children were grouped in class intervals of four months, or one-third of a year, beginning with those of four years four months. In studies of any factor of growth, repeated observations of the same individual furnish the most reliable series, but such observations can only be made over a long period of years. In calculating the averages for this series, however, statistical devices were used which offer an approximation, at least, of such a series. They were worked out by Professor Boas.

Briefly, the method was as follows: At each age the percentage of children having erupted a particular tooth was calculated. The difference between the percentage erupting the tooth in one age group and the percentage erupting it in the next age group was set down as the number of children having erupted the tooth within a given age group. This was done for the whole series. We had, therefore, a series comparable to that of one hundred children under continuous observation for the whole teething period. There was one difficulty, however; in some cases the percentage erupting the tooth at one age period was actually less than the percentage at an earlier period.

TABLE II—AVERAGE AGE IN YEARS AT WHICH DECIDUOUS TEETH ARE SHED

ITALIAN GIRLS

	Right Side		Left Side	
	Average	S. D.	Average	S. D.
Upper Set				
Central Incisor	6.88	1.21	7.18	.81
Lateral Incisor	8.15	1.12	8.28	1.14
Canine	10.79	1.53	11.09	1.30
Molar I	10.38	1.80	10.14	1.18
Molar II	10.37	1.70	10.89	1.53
Lower Set				
Central Incisor	6.36	1.74	6.57	.75
Lateral Incisor	7.49	.94	7.65	.87
Canine	9.80	1.18	10.07	1.25
Molar I	9.60	2.20	10.47	1.36
Molar II	9.99	2.60	11.13	1.52

*The terms canine and premolar are sometimes used in popular parlance, in referring to the cuspid and bicuspid, respectively.—Ed.

TABLE III—AVERAGE AGE IN YEARS AT WHICH PERMANENT TEETH ERUPT

ITALIAN BOYS

	Right Side		Left Side	
	Average	S. D.	Average	S. D.
Upper Set				
Central Incisor	7.49	.93	7.73	1.02
Lateral Incisor	8.64	1.22	8.93	1.18
Canine	11.50	1.50	11.90	1.33
Premolar I	10.37	1.87	10.47	1.99
Premolar II	11.04	1.81	11.20	2.05
Molar I	6.66	.84	6.42	.95
Lower Set				
Central Incisor	6.74	1.03	6.98	1.78
Lateral Incisor	7.88	.93	7.98	1.03
Canine	11.28	1.53	11.50	1.71
Premolar I	10.45	1.80	11.39	1.70
Premolar II	11.71	1.86	12.09	1.76
Molar I	5.87	.90	6.21	1.12

Were the same group of children under observation this, of course, could not occur. A method was worked out by Professor Boas for allowing for these "errors," which are due to random sampling of various age groups.

The average ages at which boys shed deciduous teeth are found in Table I; similar averages for girls are found in Table II. Except for upper right, molar I (first deciduous molar) the girls shed all their teeth earlier than boys. The girls are therefore accelerators in the shedding process as compared with boys. The boys have also a wider range of variability. For both boys and girls the teeth on the right side of the mouth in every instance are shed earlier than those on the left side. Another striking characteristic is brought out in this comparison. Except for the deciduous molars on the left side for both boys and girls and the first deciduous molars on the right side for boys, the lower teeth are shed earlier than the upper.

In the eruption of permanent teeth girls are again accelerated as compared with boys. This is brought out in comparing Table III, which gives the average ages of eruption of permanent teeth for boys, with Table IV, which gives similar averages for girls. The differ-

TABLE IV—AVERAGE AGE IN YEARS AT WHICH PERMANENT TEETH ERUPT

ITALIAN GIRLS

	Right Side		Left Side	
	Average	S. D.	Average	S. D.
Upper Set				
Central Incisor	7.54	.90	7.13	.92
Lateral Incisor	8.46	1.17	8.24	1.09
Canine	11.12	1.27	10.96	1.31
Premolar I	10.03	2.03	9.91	1.44
Premolar II	10.66	1.43	10.71	1.35
Molar I	6.36	1.03	6.36	.75
Lower Set				
Central Incisor	6.40	1.04	6.56	.76
Lateral Incisor	7.55	.93	7.57	.90
Canine	9.82	1.14	9.99	1.20
Premolar I	10.35	1.44	10.34	1.41
Premolar II	11.07	1.54	10.94	1.68
Molar I	5.80	1.11	6.09	.73

ence is greatest in the lower canine teeth for both right and left sides. In each case girls erupt the lower canines about a year and a half earlier than boys. In general lower permanent teeth are erupted earlier than the upper teeth for both sexes. Again the exception is in the case of both premolars (usually called first and second bicuspids). This exception holds for both sides of the mouth and for both sexes. It is to be noted that while with boys the teeth on the right side erupt before those on the left, as in the case of the shedding of temporary teeth, for the girls the reverse order is followed for the upper set. In the lower jaw, however, except for Premolar II, the right side precedes the left.

We should expect the eruption of those permanent teeth which displace corresponding deciduous teeth to take place at a later time. Obviously any departure from this procedure means that the temporary tooth will crowd the permanent tooth out of position. While this occasionally happens, we were surprised to note that in the case of Italian girls this abnormality is the rule for all teeth on the left side. The average age for eruption of permanent teeth on the left side for both upper and lower is earlier than the shedding of the temporary teeth they are to replace. While the differences are slight for the most part, the upper permanent permolars erupt about three months before their time. On the right side of the jaw, however, it is only the first upper premolar which erupts before the corresponding temporary tooth is shed. The reason this condition is found to be so marked for the left side of the mouth in girls is that the sequence of shedding and eruption in their case is reversed. We have just seen that while both sexes shed the teeth on the right side first, the girls erupt the teeth on the upper left before the upper right. With the boys this abnormality is less marked and the differences are so slight as to have little significance. In this connection it may be pointed out that Dr. Kinney has frequently noted this characteristic among the children of the district and has called it to the attention of her colleagues.

How does the dentition of the Italian children compare with other racial and social groups? The answer to this question will go far to answer our main question: are the Italian children living in a congested district of New York City retarded in their physiological development? It is unfortunate that we have no record of the dentition of Italian children living under favorable conditions, for such material would enable us to determine whether the order of dentition of this group of children is influenced more by their standard of living than by heredity. In this connection, the study of Dr. Hellman, previously referred to, is most illuminating. Dr. Hellman found interesting and significant differences in the dentition of two distinct groups of Jewish children, the one group coming from families in good circumstances and receiving excellent physical care, the other coming from families dependent upon philanthropic societies for support. For convenience the former are designated "wealthy," the latter "poor." We may assume, therefore, that if the Italian children resemble the "poor" Jewish children in their dentition more than the "wealthy" Jewish children, their order of dentition is largely determined by environmental causes.

In Table V the average at which deciduous teeth are shed and the order in which they are shed is noted for the two groups covered in Dr. Hellman's study and for Italian children as well. This table indicates that the Italian children

TABLE V—AGE FOR SHEDDING THE DECIDUOUS TEETH

"Wealthy" Jewish, "Poor" Jewish and Italian Children Compared

Teeth	Jewish "Wealthy" Average	Jewish "Wealthy" Order	Jewish "Poor" Average	Jewish "Poor" Order	Italians Average	Italians Order
BOYS						
Upper Set (Right Side)						
Central Incisor	7.10	1	7.13	1	7.41	1
Lateral Incisor	8.16	2	8.45	2	8.16	2
Canine	11.47	4	11.31	5	11.55	5
Molar I	10.67	3	9.41	3	9.58	3
Molar II	11.47	5	10.13	4	10.36	4
Lower Set (Right Side)						
Central Incisor	6.44	1	6.65	1	6.75	1
Lateral Incisor	7.44	2	7.74	2	7.85	2
Canine	10.57	3	10.97	5	10.86	5
Molar I	10.84	4	8.72	3	9.93	3
Molar II	11.65	5	9.26	4	10.10	4
GIRLS						
Upper Set (Right Side)						
Central Incisor	6.80	1	7.21	1	6.88	1
Lateral Incisor	7.60	2	8.30	2	8.15	2
Canine	10.72	4	10.78	5	10.79	5
Molar I	10.32	3	9.15	3	10.38	4
Molar II	11.06	5	10.01	4	10.37	3
Lower Set (Right Side)						
Central Incisor	6.15	1	6.55	1	6.36	1
Lateral Incisor	6.97	2	7.59	2	7.49	2
Canine	9.75	3	9.77	5	9.80	4
Molar I	10.13	4	8.84	3	9.60	3
Molar II	10.79	5	9.07	4	9.99	5

both in the order of the shedding of temporary teeth and in the age at which shedding occurs more closely resemble the "poor" Jewish children. Indeed, so far as the order of shedding is concerned the agreement in the case of the "poor" Jewish and Italian boys is complete and the agreement in age is very close. The agreement in the case of girls, however, is not complete either as regards order or age. There is close agreement in all groups with respect to the shedding of incisors.

Since the Italian children have shown a tendency to retain temporary teeth beyond the period of the eruption of permanent teeth we must look to the comparison of the eruption process for a more valid comparison of the dentition of the three groups. In Table VI the three groups are compared with regard to the eruption of the first six permanent teeth. With one exception only, the order of the eruption of permanent teeth is the same for both "poor" Jewish and Italian children. The single exception occurs in the eruption of lower Premolar I. With the Italian group this is the fourth

TABLE VI—AGE FOR ERUPTING PERMANENT TEETH

Teeth	Jewish "Wealthy" Average	Jewish "Wealthy" Order	Jewish "Poor" Average	Jewish "Poor" Order	Italian "Poor" Average	Italian "Poor" Order
BOYS						
Upper Set (Right Side)						
Central Incisor	7.41	2	7.45	2	7.49	2
Lateral Incisor	8.76	3	8.99	3	8.64	3
Canine	12.02	5	12.16	6	11.50	6
Premolar I	10.91	4	10.37	4	10.37	4
Premolar II	12.06	6	11.25	5	11.04	5
Molar I	6.77	1	6.50	1	6.66	1
Lower Set						
Central Incisor	6.48	1	6.77	2	6.74	2
Lateral Incisor	7.68	3	7.90	3	7.88	3
Canine	11.04	4	11.17	4	11.28	5
Premolar I	11.26	5	11.33	5	10.45	4
Premolar II	12.03	6	12.07	6	11.71	6
Molar I	6.89	2	6.35	1	5.87	1
GIRLS						
Upper Set						
Central Incisor	6.80	2	7.37	2	7.54	2
Lateral Incisor	8.21	3	8.62	3	8.46	3
Canine	11.15	5	11.13	6	11.12	6
Premolar I	10.52	4	9.91	4	10.03	4
Premolar II	11.47	6	10.69	5	10.66	5
Molar I	6.14	1	6.47	1	6.36	1
Lower Set						
Central Incisor	6.05	1	6.48	2	6.40	2
Lateral Incisor	7.15	3	7.65	3	7.55	3
Canine	9.98	4	9.80	4	9.82	4
Premolar I	10.54	5	10.70	5	10.35	5
Premolar II	11.57	6	11.29	6	11.07	6
Molar I	6.39	2	6.23	1	5.80	1

tooth erupted in the lower jaw (right side), while with the "poor" Jewish it is the fifth.

If we may assume that the "wealthy" Jewish children, because of more favorable living conditions, are of accelerated development and the "poor" Jewish and Italian children because of adverse living conditions are relatively retarded, then the differences in dentition between the first and the other two groups may be attributed to physical retardation. While possible racial differences must be borne in mind, the comparison of the heights and weights of the three groups will help to determine relative retarda-

TABLE VII—AVERAGE HEIGHTS OF "WEALTHY" JEWISH, "POOR" JEWISH AND ITALIAN CHILDREN COMPARED

Age in Years	BOYS Jewish "Wealthy"	BOYS Jewish "Poor"	BOYS Italian	GIRLS Jewish "Wealthy"	GIRLS Jewish "Poor"	GIRLS Italian
5		40.7	39.4		40.8	39.0
6	46.3	42.9	41.5	46.7	43.2	41.5
7	49.1	46.3	44.0	49.1	44.9	43.8
8	50.5	47.4	46.2	51.0	47.1	46.2
9	52.5	49.2	48.0	52.3	50.2	47.7
10	53.9	49.3	49.9	55.5	50.9	50.1

TABLE VIII—AVERAGE WEIGHTS OF "WEALTHY" JEWISH, "POOR" JEWISH AND ITALIAN CHILDREN COMPARED

Age in Years	BOYS Jewish "Wealthy"	Jewish "Poor"	Italian	GIRLS Jewish "Wealthy"	Jewish "Poor"	Italian
5		40.4	38.6		39.3	37.0
6	47.4	42.5	42.1	51.6	42.7	40.7
7	53.9	48.8	46.6	54.3	45.6	44.9
8	60.3	54.4	51.4	60.9	50.7	48.8
9	65.4	58.4	56.2	64.6	60.4	53.6
10	69.6	65.2	60.6	75.1	63.2	59.2

tion among the "poor" Jewish and Italian children.

Dr. Hellman has given the average heights and weights of the children included in his dentition study. In Table VII the heights of the two groups of Jewish children and of the Italian children are given for those ages where comparable data were available. It is apparent at once that the "poor" Jewish children are retarded in stature as compared with the "wealthy" Jewish children. "Poor" Jewish boys are from 3 to 4 inches shorter than the well-to-do of the same race. Among the girls the difference is even greater, reaching 4.6 inches at ten years of age. The Italian children are slightly shorter than either group, though this may be partly explained by the fact that in the other groups heights were taken with shoes.

Similarly weights have been compared in Table VIII. Here the differences are not so marked but it must be pointed out that among older children not included in this table the "wealthy" Jewish children were much heavier; for at puberty the difference was from 10 to 13 pounds. For the ages given, the Italian children fall farther below the "poor" Jewish than that group falls below the "wealthy."

It seems evident, therefore, that both the "poor" Jewish and Italian children are retarded as compared with the "wealthy" Jewish children. Let us see if this retardation is manifested in dentition. To bring this out more clearly Tables IX and X have been constructed.

While the "poor" Jewish children are retarded in the eruption of the incisors and canines they are accelerated in the upper premolars and in both first molars. It is surprising to find retardation in

TABLE IX—RETARDATION AND ACCELERATION IN DENTITION IN YEARS OF "POOR" JEWISH AND ITALIAN BOYS AS COMPARED WITH "WEALTHY" JEWISH BOYS

(Right Side Only)

Tooth	"Poor" Jewish Retarded	"Poor" Jewish Accelerated	Italian Retarded	Italian Accelerated
Upper Central Incisor	.04		.08	
Lower Central Incisor	.29		.26	
Upper Lateral Incisor	.23			.12
Lower Lateral Incisor	.22		.20	
Upper Canine	.14			.52
Lower Canine	.13		.24	
Upper Premolar I		.54		.54
Lower Premolar I	.07			.81
Upper Premolar II		.81		1.02
Lower Premolar II	.04			.32
Upper 1st Molar		.27		.11
Lower 1st Molar		.54		1.02

TABLE X—RETARDATION AND ACCELERATION OF DENTITION IN YEARS OF "POOR" JEWISH AND ITALIAN GIRLS AS COMPARED WITH "WEALTHY" JEWISH GIRLS

(Right Side Only)

Tooth	"Poor" Jewish		Italian	
	Retarded	Accelerated	Retarded	Accelerated
Upper Central Incisor	.57		.74	
Lower Central Incisor	.43		.35	
Upper Lateral Incisor	.41		.25	
Lower Lateral Incisor	.50		.40	
Upper Canine		.02		.03
Lower Canine		.18		.16
Upper Premolar I		.61		.49
Lower Premolar I	.16			.19
Upper Premolar II		.78		.81
Lower Premolar II		.28		.50
Upper First Molar	.33		.22	
Lower First Molar		.16		.59

growth, accompanied by acceleration in the eruption of certain teeth. This anomaly is even more marked among Italian boys, for with them there is an acceleration in the eruption of all the premolars and first molars and in the upper canines and upper lateral incisors as well.

The agreement between the "poor" Jewish and Italian girls with respect to retardation and acceleration is even more marked. In fact, in only one instance is one group retarded and the other accelerated. The "poor" Jewish girls are slightly retarded in the eruption of the lower first premolar (.16 year), while the Italian girls are accelerated by a similar degree (.19 year) in the eruption of this tooth.

CONCLUSIONS

The study of the dentition of Italian children may be summarized as follows:

(1) As compared with boys, girls are accelerated both in the shedding and eruption of teeth. The same phenomenon has been noted in all studies of dentition which have included both sexes.

(2) Except for the first and second molars on the left side, temporary teeth in the lower jaw are shed earlier than those in the upper jaw. Similarly, except for the premolars, on both sides permanent teeth erupt earlier in the lower jaw.

(3) In the case of girls there is a marked overlapping of the shedding and eruption processes, i.e., certain permanent teeth erupt before the corresponding temporary teeth have been shed.

(4) Both boys and girls shed the temporary teeth on the right side before the left. Boys also erupt permanent teeth on the right side first, but girls erupt the permanent teeth on the left side first. This shift in the order of eruption accounts for the overlapping of the shedding and eruptive process in girls.

(5) So far as we may judge by comparing our results with Jewish children, physical retardation is accomplished by retardation in the shedding and eruption of incisors and certain of the canines, but by an acceleration in the eruption of molars and premolars (bicuspids).

(6) Physical retardation as expressed in dentition is apparently more marked for Italian than Jewish children, but this may be partly due to a racial characteristic.

A SERVICE FOR CHILDREN

A nation-wide service for the betterment of child life is being carried on by a comparatively new organization known as the Children's Foundation. It is a timely service.

So long as the average father gives more attention to the gear teeth of his automobile than he gives to the teeth of his children; so long as intelligent mothers can be found who know more about the rules of bridge than about rules of hygiene; so long as both fathers and mothers are more concerned about the bank balance than about a balanced ration for their children, just so long will there be need of agencies to help educate parents in the care of their offspring. To such a program of education the Children's Foundation is committed.

The Foundation came into existence at Valparaiso, Indiana, late in 1921, when a charter was granted to it, by the State of Indiana, as a corporation not for profit, and its president and founder, Mr. Lewis E. Myers, made funds available to its trustees for effecting its organization and developing its program of work.

The Children's Foundation is seeking to make available and understandable to parents, teachers, professional men and women and all concerned with the care of children, whatever of vital and fundamental importance in child nature, well-being and education has been or may be discovered by scientific investigators throughout the world. That a wide gap exists between these two general groups we know. We know also that far too little has been accomplished in applying in any general way the results of such research as has already been accomplished.

The scientific investigator has been inclined to say: "I have no time to stand on the street corner and tell the people about the facts I have been finding in my laboratory. Neither have I the time to popularize my written reports. If those who are charged with the health and the education of the young care to profit by my findings, they will have to learn to talk my language. I cannot be an investigator and a teacher of the public at the same time."

On the other hand, the parent, the teacher, the social worker, the average professional man and woman each has been saying: "I cannot understand the technical language of these scientists. And anyhow I am too busy with practical matters to take the time or expend the energy necessary to get hold of these technical matters. Until someone shows me a simple, practical way of applying what the scientists are discovering about the nature and needs of children, I'll have to go along about as I've been doing."

It is encouraging to know that this movement is under way to help give wider application to the findings of the laboratory and the research station.

As a first step in this program of raising the general level of understanding and practice in child culture, the Foundation has prepared a survey "The Child: His Nature and His Needs," in which the contributors undertake to review and interpret present-day knowledge pertaining to child nature, well-being and education. The result is the most comprehensive and readable volume of this kind that has yet come from the press.

Sixteen outstanding specialists contributed to this survey. The editorial work was done by Dr. M. V. O'Shea, who wrote the closing chapters of the volume. Of special interest to our readers are such chapters as "Relation of Nutrition to Mental Development," by William R. P. Emerson of Tufts Medical College; "Nervous and Mental Hygiene Among Children in Present-Day Life," by William A. White of St. Elizabeth's Hospital and Georgetown University; and "The Prevalence and Treatment of Sense Defects," by C-E. A. Winslow of Yale Medical School. But it is hardly fair to single out special chapters, because the whole volume can be read with much profit. It is a veritable mine of information.

This volume, which contains considerably more than 500 pages, is beautifully bound and profusely illustrated. It contains an extensive bibliography and a comprehensive index, both of which add greatly to its value.

The Foundation's plan for distributing its first public contribution "The Child: His Nature and His Needs" is unique and most generous. To anyone in the United States subscribing one dollar to the Publication Fund of the Foundation, the volume is sent, postage paid. This amount is very much less than the actual cost of producing so unusual a volume, and this basis is made possible only because the trustees have funds available for subsidizing the distribution.

The home office of the Children's Foundation is at Valparaiso, Indiana.

FOOD POSTERS

Several inquiries have been received concerning the posters on vitamins and iron in food, which were put out by the American Medical Association. These were shown on page 351 of the March Journal. They (22″ x 28″) may be purchased for 20c each from the Propaganda Department, American Medical Association, 535 North Dearborn St., Chicago, Ill.

NEW PICTUROLS

Through the courtesy of Dr. Thomas B. McCrum, of Kansas City, Mo., the Department of Dental Health Education announces two new picturols.

The first, "Growth of the Teeth," consists of twenty-seven pictures showing the normal development of the jaws and teeth. The dentition at birth, at 1 year, 2½, 5½, 6, 7½, 11 and 13 years of age is shown. Other pictures show abnormal development by means of plaster models as well as photographs of the individuals from whom the impressions were taken. Plaster models demonstrate the effect of dental caries on the efficiency of the teeth as a chewing machine.

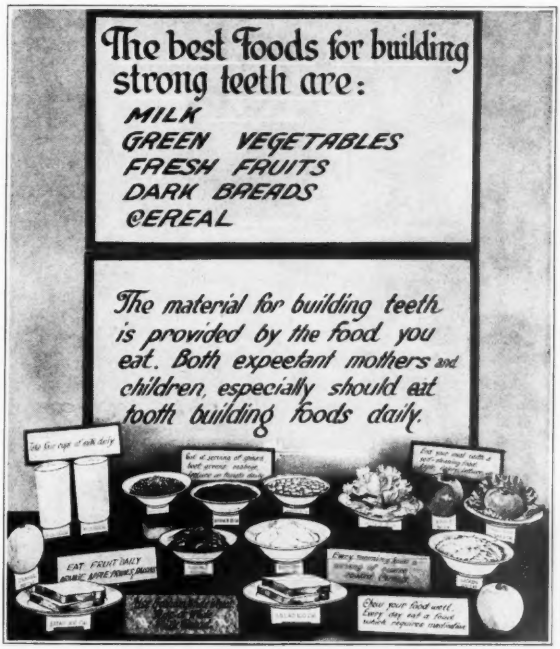
The other picturol, "Sound Teeth Depend Upon Three Things," consists of thirty-one pictures. The nutritional aspect is emphasized first. Here the foods that are best sources of tooth-building materials are listed. Charts show the proportion of calcium phosphate and fluorid, calcium carbonate, magnesium phosphate, other salts and cartilage, in tooth enamel and dentin. Charts also show the relative amount of calcium, phosphorus and iron in the common foodstuffs. The second aspect deals with cleanliness. Here the "down on the upper teeth and up on the lower teeth" method is advocated. Lime water is suggested as a mouth wash. The third step is dental care. "Time to begin at 2½ years. Have your teeth cleaned and examined every three months by your dentist."

Either of these picturols may be purchased for $2.50 or may be rented with the picturol machine.

"EATING FOR TEETH" EXHIBIT

This exhibit was worked up with the idea of showing how simply and inexpensively an exhibit may be executed.

The food models, uncolored, may be obtained from the University of Chicago Bookstore, 5802 Ellis Ave., Chicago, Ill. (Food Models by Lydia J. Roberts, price 75c).


The best foods for building strong teeth are:
MILK
GREEN VEGETABLES
FRESH FRUITS
DARK BREADS
CEREAL
The material for building teeth is provided by the food you eat. Both expectant mothers and children especially should eat tooth building foods daily.

"Eating for Teeth" Exhibit

The signs may be made by any sign painter. They read:

1. Eating for teeth.
2. The material for building teeth is provided by the food you eat. Both expectant mothers and children, especially, should eat tooth building foods daily.
3. The best foods for building strong teeth are:

   Milk and the dairy products
   Green vegetables
   Fresh fruits
   Whole grain or milk-made bread
   Cereals

The small signs read:

1. Eat a serving of spinach, beet greens, cabbage, lettuce or tomato daily. 2. Eat fruit daily; orange, apple, prunes, raisins. 3. Take four cups of milk daily. 4. Every morning eat a serving of coarse, cooked cereal. 5. End your meal with a self-cleansing food: apple, celery, lettuce, etc. 6. Chew your food well. Every day eat a food which requires chewing. 7. Always use graham, whole wheat and rye bread.

At such an exhibit, a flyer with a message in a popular tone, a recipe for good teeth, similar to the following, might be distributed:

TEETH

Milk	4 cups
Spinach	4 tbsp.
Orange	1
Graham Bread	6 slices
Oatmeal	¾ cup

Put these ingredients into a healthy mouth daily; chew thoroughly; wash chewing ma-

chine carefully with a toothbrush after using. This recipe helps make thirty-two strong teeth.

Note: The following may be substituted:

For spinach: lettuce, cabbage, celery, beet greens, etc.

For orange: apple, prunes, apricots, peaches, dates, etc.

For graham bread: any whole grain bread.

For oatmeal: any coarse, cooked cereal.

A Dental Ambulance

A DENTAL AMBULANCE

The dental ambulance of the Bureau of Child Hygiene of the New Jersey Department of Health houses a traveling dental clinic and is for use in the rural districts where there is either no dentist or the resident dentists have not sufficient time to give to the care of the preschool and school child. The ambulance is fully equipped for ordinary dental work. It is loaned to any community on request of a responsible person, such as the county superintendent of schools or the public health nurse. The cost of operating the ambulance is about $300 or $350 a month, depending on the salary paid the dentist. This money is collected through the parent-teacher associations and civic clubs, and a small sum is raised by charging a nominal fee for the children receiving treatment. There is no dentist permanently engaged for the ambulance, but when the demonstration is made in a rural community, the dentist is engaged by the authorities taking charge of the demonstration. Recently in a demonstration 2,630 children were examined, 2,444 treatments were given and there were 1,197 extractions made.

In one rural community in which the ambulance was recently operating, it was reported that dental care was given school children who had never before been in a dentist's chair.

"KINDERGARTEN METHODS OF TEACHING ORAL HYGIENE"

An exhibit entitled "Kindergarten Methods of Teaching Oral Hygiene," presented by Minnie M. S. Proctor, D.D.S., in the Oral Hygiene exhibit at the annual session of the American Dental Association held at Dallas, Texas, includes the group of articles shown in the accompanying photograph. This set has proved particularly useful in schoolrooms that do not have facilities for showing slides or moving pictures. Part of it may be used in dental offices or on the lecture platform.

Dr. Proctor, as a member for many years of the Los Angeles school health staff, saw an endless procession of little children with broken, decayed and abscessed teeth. Her experiences suggested the need for this little set of charts and stories, and it is hoped that they may suggest other ideas and thus further help to supply the need for material of this kind. The set consists of three groups:

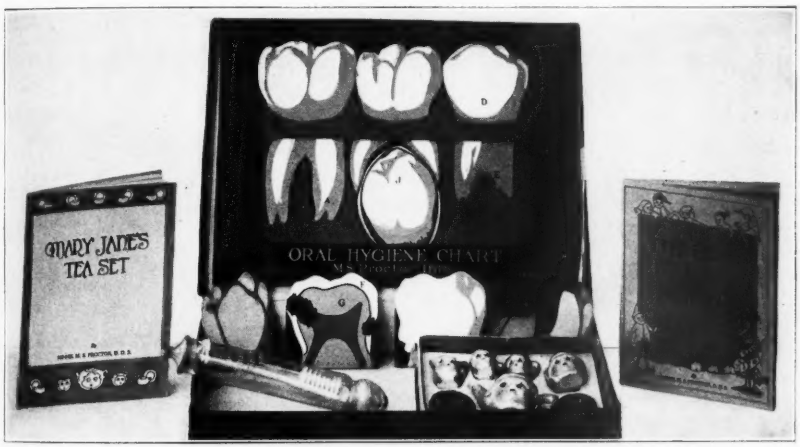
Group I which contains the little story "Mary Jane's Tea Set," is suitable for children in the kindergarten and first grades. The health worker may present the story or a part of it, in closing, showing the tea set and emphasizing the need for keeping the teeth clean just as dishes must be kept clean.

Group II, can with a few changes be used in grades 4 to 8. This includes a little book called the D. Kay Brownies, the presentation of whose story is much like a guessing contest. The blackboard is used in illustrating the story.

The sterile toothbrush holder, which is a part of this group, is an ideal container for the brush used in demonstrations.

Group III is useful in advanced grades and in giving lectures to mothers. It contains an oral hygiene chart with a sliding feature which illustrates the exfoliation of a deciduous tooth and the normal eruption of a permanent tooth. An envelop on the back of the chart contains three extra teeth that can be slipped into the slot.

The set can be obtained from Jones Book Store, 426 West Sixth street, Los Angeles, Calif. Price $7.00, postage prepaid, anywhere in the U. S. A.



Kindergarten Methods

FIELD NOTES*

The North Pacific College of Dentistry and Pharmacy offers a special course to dental assistants, consisting of one full session of eight months. N. G. Lehr, East Sixth and Oregon streets, Portland, Ore., is the registrar.

The Massachusetts State Dental Society placed inside the convention number of their bulletin a pamphlet on "Cancer Control: How the Dentist Can Help Forward Its Accomplishment" which is published by the American Society for the Control of Cancer, 370 Seventh Ave., New York City. This is a concise informative article which might well be circularized among the dental profession in every state. Copies will be furnished gratuitously on request. Address the American Society for the Control of Cancer.

*The Department of Dental Health Education will be glad to receive items of news along the lines of education in dental or general health.

The Journal of the American Dental Association

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Editorial

"I HAVEN'T TIME TO READ"

Tradition has it that a certain queen once offered a million pounds or some similar sum for two minutes of time. She had the money and doubtless would have paid it had a vender been about with the commodity she craved. The reason for the size of the sum offered was that the lady was dying, and two minutes more of this world with its grime and grief, its labor and worry was more alluring than the gilded, carefree, untroubled eternity of saints and seers. A great curiosity has always accompanied this tale for me. I have wanted to know what with her furtive, anxious, uncertain fingers the lady would have done with the time. What life-completing queenly performance did she plan for those precious minutes? It is a ridiculous story, told for a purpose of which it utterly fails.

Yesterday, today and tomorrow, there were, there are, there will be pairs of minutes infinitely more important, far more precious, abounding in usefulness. In those two, we are interested; they deserve our interest. They are the stuff of which life is made, accomplishment, success, nonaccomplishment or failure. They bring the elixir that keeps the protoplasm of body and mind fluid, amenable, capable of function, or the ingredients that clog the vital activities and fix the mystic stuff in indissoluble calcification. Those minutes tick off opportunities for the fulfilment of dreams, the accomplishment of ambitions, or toll the loss of the chance to be what most men at some time desire to be. What they shall portend depends on the choice, the will of the man whose concern life is.

When one talks of time, one talks of life. Time is meaningless, unimportant apart from life. As there can be no sound where there is no hearing, so there can be no time where nothing lives. Time is marked off on the measure of cosmic existence in the millimeters and centimeters of the lives about us. "All a man hath will he give for his life," said one philosopher; but around him at the time he spoke were folk who were trying to find ways to kill time. He, like the queen, was speaking in terms of the dying; what I am quoting are the incongruous terms of

the living. Kill time! A curious murder! But not of time—it resists the whirl of suns and stars. It can't be killed. What one kills is oneself. The deed is suicide!

"I haven't time to cast my vote." "I haven't time for the call at the hospital." "I haven't time to visit a friend." "I haven't time to go to church." "I haven't time to read." These are scraps of speech as common as people are common. The last interests us most in this context, for it is as recurrent as meal times and as dangerous as disease. The naivete with which it is said is shocking in its simplicity. Not often is a man willing to place on himself a brand so damning and do it so jauntily. And of course the skeptic standing by wonders doubtingly if this man is so conservative of his minutes that all are loaded with the treasure of accomplishment.

There is time in any day for any man to do what is necessary to that man's happiness, to his success, to his advancement, to the maintenance of his self-esteem. Exactly that, too, is involved in the repeated asservation by professional men, "I haven't time to read." The exact meaning of the phrase must seldom percolate to the consciousness of the man who uses it. "I haven't time to keep abreast with my profession." "I haven't time for the stimulus of progressive frictional thinking." "I haven't time to vitalize and inspire my own flagging brain with new ideas." "I haven't time to realize that I am outsped in my work, left behind in my service, a danger and a threat to those who seek me." Would such a man seek another who proclaims his own mental stasis in that fashion? "I don't have time to read," supports two possible interpretations: either "I do not need to read" indicating a self-asserted superiority, or "I am indifferent to the needs and possibilities of my own calling." Who would risk such an epigram placed on his office wall? "I HAVEN'T TIME TO READ!"

If one is mathematically inclined, it would be easy to accumulate a wealth of minutes from any man's month or year that have been bartered for vagaries or vanities. Of most days of most men it might be said that there are more lost minutes between jobs than were required for jobs. A review of yesterday will show to any honest eye time that was squandered, wasted—as we say, killed. The minutes, the quarters, the halves of hours that are lost bestud most days like punctuation marks; but we smoked or read the blighting excesses of the daily or lingered for another yarn—simply idled, dawdled, trifled the time away. Occasionally, one insists that he spends his days from dawn to dusk in work and hasn't time to read. Then that one's sense of values is distorted, confused. Something that he does is waste by comparison with the benefit he may obtain by an hour of reading.

The man who hasn't time to read gives return to a dash of history. The disciples of Mahomet declared that if any books contained what was to be found in the Koran, they were not needed; if they differed from the Koran, they were wicked and should be destroyed; so they burned the library at Alexandria. It is significant that no African shore has since supported a library. Africa is a bookless land. Who would make bookless this land? One constructs a land of fading intelligence, of diminishing accomplishment, of decading civilization. A bookless land is an enlarged picture of a bookless man. Such a man may be visualized as a part of a going age, simply removed from its amenities. He may be described in words of charm and attractiveness. His native culture may play about him like sifting sunlight, but such a man cannot be a professional man.

Men indulged their senses and appetites long before the cerebral cortex claimed supremacy. This, biologists say, explains the ease of performance and the enjoyment in practice of sheer physical pleasure. For the reason given, minds readily subserve the luxury of taste-buds and gastronomics. Human pleasures range from the border of four-footeddom to the thrill the philosopher knows in thought, the poet in his rhapsody, the musician in the assembly of sounds, the inventor in the enslavement of natural processes. All the way between are found minds at work and play, each with its tools and toys. Far up the scale is professional intelligence. Its place is conceded. How can a man then prove his right of position when, with unshamed face, he declares "I haven't time to read"?

DANGEROUS LEGISLATION

What may be considered the most unique piece of dental legislation on record is found in a bill recently passed by the legislature of Tennessee. The text of the bill is as follows:

SENATE BILL NO. 567

(BUTLER)

Ch 279

An act to regulate the practice of dentistry in all counties of this state having a population of not less than 12,225 and not more than 12,235, according to the Federal census of 1920, or any subsequent Federal census, and repealing all laws and parts of laws in conflict with the provisions of this act.

Section 1.—Be it further enacted by the General Assembly of the State of Tennessee: That in all counties in this State having a population of not less than 12,225 and not more than 12,235, according to the Federal Census of 1920, or any subsequent Federal Census, any person or persons who have been engaged in the practice of Dentistry within the State of Tennessee, at the time of the pas-

sage of this Act, for five years or more and who may be a graduate of mechanical dentistry are hereby licensed to practice dentistry in said county or counties within the provision of this Act.

Section 2.—Be it further enacted: That when proof of the fact that any person or persons, in counties coming within the provisions of this Act, have so practiced for five years and are graduates of mechanical dentistry and of good moral character is filed with the Clerk of the County Court of such counties it shall be the duty of the Clerk of such Court to register said applicant as a licensed dentist to practice in the county or counties coming within the provision of this Act; or at the discretion of the applicant he may file such proof to the State Board of Dental Examiners of this State and it shall be the duty of said Board to issue to said applicant a certificate licensing the applicant to practice dentistry in the counties coming within the provision of the Act, said applicant paying the legal fees therefor.

Section 3.—Be it further enacted: That all laws and parts of laws in conflict with the provision of this Act are hereby repealed and that this Act take effect from its passage, the public welfare requiring it.

Passed, April 1, 1925.
L. D. Hill, Speaker of the Senate.
W. F. Barry, Speaker of the House of Representatives.
Austin Peay, Governor.
Approved, April 2, 1925.

Freak legislation granting special privileges to individuals has from time to time been enacted by the legislatures of various states, but it remained for Tennessee apparently to go out of its way to pass one of the most retrogressive measures in existence, as far as a proper protection of the people is concerned. Granted that the foregoing bill affects only one county in the state, and probably has reference to only one individual in that county, the principle of protective and sane legislation for the people has been so outraged by its passage that it will stand as a blot on Tennessee till it is repealed. Why, forsooth, should the citizens of one county be turned over to the dental care of a man who, as far as the provisions of the act are concerned, has had no preparation whatsoever in some of the most important aspects of dental practice? Does the legislature for one moment think that the beneficiary or beneficiaries of this bill propose to confine themselves to the practice of that department of dentistry in which they have received instruction? Of course not. The state legislature deliberately turned over the people of this particular county to the untender mercies of a man or men who, for all intents and purposes, may be as ignorant as a hod carrier of the most essential principles of dental practice. Those men are legalized to use the most deadly drugs in the mouths of the people without the slightest test being made to determine whether or not they know the least thing about them. In some respects, the citizens of a community coming under the provisions of this act are in a worse condition today, as far as

dental service is concerned, than were the citizens of states in earlier days where there were no dental laws at all. The citizens of those days knew that they were not protected, and were therefore inclined to use some discrimination in the selection of their dentist. At least, they were under no misconception of the situation. But in this instance the legislature of a great state has set its seal of approval on the ability of a man or men to take proper dental care of the people regardless of any knowledge of dental subjects: the most pernicious piece of legislation that has been enacted in many a day.

And while it grotesquely provides that a change in the population of any county amounting to ten citizens will nullify the act, it is still the entering wedge of retrogressive enactment whereby, in an unwary moment, an amendment might easily be slipped in making the act apply to counties of 20,000 or 40,000 or even 100,000.

And what is the logic of this bill? Has the legislature of Tennessee concluded, in its wisdom, that the people of a county within the magic number of between 12,225 and 12,235 have less right to adequate protection than the remaining citizens of the state? Has Tennessee a county containing just that number of citizens so very disreputable that they alone of all the rest of the State are not entitled to protection? The situation is more absurd than any that has ever arisen in dental annals, and the only logical and equitable solution of it is to have the splendid State of Tennessee redeem herself by repealing that law at the earliest possible moment. Till this is done, it will remain a blot against the fair name of a great commonwealth.

C. N. Johnson.

"POSTGRADUATE STUDY"

March 13, 1925.

Dr. Otto U. King,
Chicago, Illinois.

My dear Doctor King:—

Just a brief line to say that The Journal, while always good, is getting better with each issue. The editorials in the recent numbers have been classics. I congratulate you on the one in the current issue on "Postgraduate Study." The only way to grasp and retain fundamentals is to study and study hard. The absorption method of learning is both superficial and fleeting. How true is the statement that "a listening club or a seeing club is not a study club."

The newer additions to The Journal "Medical and Dental News" and "Extracts and Abstracts" from current literature have greatly improved the magazine. Again I congratulate you and wish you continued success.

Very truly yours,
J. P. Buckley, Hollywood, California.

Medical and Dental News

CONNECTICUT

Hartford Dental Clinics: The Hartford Free Dispensary is maintaining a free dental clinic, recently reorganized, and supported by contributions from local dentists and friends, with two new chairs and necessary equipment. One dentist, paid for part time, is in attendance for filling and treatments. Dental hygienists are present three mornings and exodontists two mornings. Each school district has a dentist in attendance and two or more hygienists are assigned to each district. The dental department of The Veterans Bureau has recently added a dental hygienist to their staff, for the Connecticut division.

Dental Works Desired for Library: Mr. G. S. Godard, curator of the Connecticut State Library is desirous of increasing the reference and dental history library. Any books of such nature will be properly acknowledged and placed at the disposal of dental research workers at all times.

Physical Examinations: The medical and dental departments of the state health board are contemplating a plan of action that will insure that the rural school districts will receive both dental and medical examination and instruction in hygiene.

Bill Concerning Hygienists: The legislation in session this winter has the following bill under consideration: Dental hygienists, in order to register in Connecticut, must be high school graduates, and must hold a certificate from a recognized training school for hygienists.

Connecticut Annual Report: The annual report of the Connecticut State Dental Commission and Dental Registration for 1924 shows 999 dentists registered, with 239 dental hygienists and 16 unlicensed assistants. There have been four deaths during the year: John H. Benedict, Danbury; T. A. Crowley, Norwich; W. J. Olagos, Westfort; N. F. Wright, Hartford. The regular monthly meeting was held in the society room, April 13. After dinner, A. R. Schirmeshorn of Newark, N. J., gave a paper on "Diastase Activity of Human Saliva and the Effects of Dentifrices Upon It."

DISTRICT OF COLUMBIA

Dental Society Banquet: The District of Columbia Dental Society held its annual banquet, Feb. 28, 1925, at the Columbia Country Club. The guests of honor for the evening were Drs. Augustus S. Downing, assistant commissioner of education of the State of New York; Honorable Royal S. Copeland, United States Senator from New York, and Honorable Henrik Shipstead, United States Senator from Minnesota. Doctor Downing talked on medical and dental education and laws, stressing the points that the members of the profession should work always to raise the standards including the amount of predental education required, and for the elimination of all fakers and quacks who may be defrauding the public as well as the profession. Doctor Downing assisted the dentists of the District in securing their new dental law, which he described as "quite as good as the New York law."

ILLINOIS

Preventive Dentistry for Newspaper Employees: The important thing about the preventive dentistry plan is that it makes good, sound, teeth compulsory. Chicago Tribune employees must keep their teeth in proper condition. or lose part of their sick benefits during illness, if such illness is found by the investigator to be due to focal infection from bad teeth. The preventive dentistry work calls for regular examination of employees' mouths, once at least, every ninety days. Upon the close of the examination, which includes a lesson in the proper way to brush the teeth, the em-

ployee is given a report of the condition of his mouth, for the use of his own personal dentist, when dental work is required. The Tribune dentist does not fill teeth, correct irregularities nor treat pyorrhea. Her work is solely prophylactic. The employee who needs a filling or a tooth pulled, goes to his own personal dentist who treats him and presents the bill to the Tribune for payment.—Nation's Health, March, 1925.

IOWA

University of Iowa Annual Meeting: The sixteenth meeting of the Alumni Association and the College of Dentistry Clinic of the University of Iowa was held at Iowa City, February 26-27. The first part of the program was given over to the college of dentistry and was a demonstration of teaching methods. The technical laboratories were in full operation, exhibits of technic models used in teaching were shown, and in the infirmary practical cases of different types of work were shown, the students being the clinicians. The second part of the program was given over to the alumni and was in the nature of a clinical program. The third part of the program consisted of lectures by Dr. Weston A. Price of Cleveland, Ohio.

NEW YORK

Antivaccination: A New York school teacher, perhaps a member of the antivaccination society, advised her pupils not to be vaccinated, on the ground that it was "a medieval custom, was harmful to the welfare of the child, and that deaths occasionally were caused by such vaccinations." Shortly afterward that same teacher died of smallpox. Evidently, as pointed out by the Health News Service of the New York Department of Health, she took her own advice, but it was fortunate that the mothers of her pupils did not. The antivaccinationists probably will dispute the diagnosis.—J. Indiana State M. A., March 15, 1925.

Reorganization of Dental Society: The Poughkeepsie City Dental Society was reorganized, January 19, under the name of the Dutchess Putnam Dental Society, including the practitioners of the two counties, about seventy in number. Bylaws were adopted, and officers were elected as follows: Stephen Palmer, president; B. A. Easten, vice-president; V. F. Downing, treasurer, and W. W. Stevens, secretary. March 17, the second meeting was held, when Dr. James T. Harrington, chief surgeon of Vassar Hospital, gave an address, regarding the establishing of a dental staff for the hospital. May 19, the last meeting of the spring will be held. Dr. W. F. Bedell will read a paper on orthodontia. Committees have been appointed, and speakers already secured for the fall meetings.

OHIO

Child Health Experiment: Toledo is planning a child health experiment which contemplates an intensive piece of health education work in a selected district in the city to determine what can be accomplished by applying the best knowledge of preventive measures to this district. An effort will be made to see that all physical defects discovered in the children in this district are corrected by the family physician. The labors of school nurses will be supplemented by district nurses. Parents in the district will be urged to have their babies and children of pre-school age examined at clinics and preventive measures such as vaccination and toxin-antitoxin treatment for diphtheria will be urged. The department of health and school authorities as well as all agencies interested are cooperating in the plan.—Bull. of Ohio Pub. Health Ass'n, March, 1925.

NEW MEXICO

Dr. Cornell on Examining Board: Dr. W. D. Cornell of Gallup, N. M., has been appointed by the governor to the Board of Dental Examiners of New Mexico, to serve five years.

NORTH DAKOTA

Reappointment of Dr. Towne: Dr. R. S. Towne of Bismarck, N. D., has been reappointed by the governor to the Public Health Advisory Council of North Dakota, for a term of six years.

OREGON

School Lunches, Oregon: Excellent practical work in providing hot lunches for children in rural schools is reported by Mrs. H. H. Dunn, principal of the Russellville School, in the Monthly Bulletin of the Oregon State Board of Health. While teaching in a region of long distances and cold winds, Mrs. Dunn noticed how often the unpalatable cold lunches brought by the children remained uneaten, and turned her attention to improving that condition. Simple cooking utensils were provided by the school board, the teacher and older children did the cooking on the Waterbury heating plant, the younger children did the dish-

washing, and the lunch hour became one of the happiest times of the day. From this beginning, Mrs. Dunn carried the hot-lunch idea to three succeeding school positions, in each making the preparation of the lunches a matter of pride and interest with the children, and enlisting the help of parent-teacher associations when possible. In Russellville, the county health nurse weighs and measures the children during the first week of school, and the cure of cases of defective nutrition becomes a matter of school interest and pride. A boys' camp cooking club and a girls' home cooking club, with enthusiastic membership, are valuable outgrowths of the hot-lunch program.

WASHINGTON

New Bimonthly Dental Bulletin: The Dentogram and the King County Medical Bulletin, official publications, respectively, of the Washington State Dental Association and the King County Medical Association, which have been in circulation for over ten years, are to be combined beginning with the May issue and will henceforth be known as the King County Medical and State Dental Bulletin, to be issued bi-monthly. The new publication, of fifty or sixty pages, will be devoted to the various activities of the local and state societies. It will also contain articles presented by the members as well as other items of professional interest.

Convention of Washington State Association: All phases of dental work—crown and bridge work, diagnosis, operative work, mouth diseases, preventive dentistry—were considered by leading dentists of the northwest in the four-day convention of the Washington State Dental Association, at Spokane, March 18-21. More than 250 delegates were present at the first sessions of the conference. The convention was a joint meeting with the British Columbia and Alberta associations, and included representatives from Oregon, Montana, Idaho, Nebraska and Illinois. The program was one of the most complete ever undertaken by northwestern dentists in the study of their profession. Drs. E. B. Edgers of Seattle and A. Starke Oliver and Dr. R. E. Shanks of Spokane were elected by the association to take charge of Washington plans for the Seventh International Dental Congress, to be held in Philadelphia in 1926.

Drs. A. Starke Oliver, D. I. Parr, Frank E. Fiske of Spokane, and Frank I. Shaw and E. B. Edgers of Seattle who have served in the state association for twenty-five years, were presented with life memberships.

The following were elected officers: A. D. Remington of Seattle, president, and W. I. Ferrier of Seattle, vice-president.

FOREIGN

Porto Rico Dental Legislation: The Porto Rico Dental Association is working hard to have the legislature approve a dental law similar to the one regulating the practice of dentistry in the state of New Jersey. There are a number of dental mechanics practicing dentistry unlawfully in the island, because of the lack of a good dental law and the ignorance of the layman.

Porto Rico Dental Clinics: Dental clinics have been established in almost all the important cities, and San Juan, the capital, has seven. They all have an up-to-date equipment with the services of a half-time dentist and a full-time dental assistant. The secretary of the association reports that there are about 145 practicing dentists in the island, and about ten graduates join the ranks yearly.

School Health in Panama: Beginning in October, 1924, annual examination of school children was inaugurated in Panama and the Canal Zone. This year, for the first time, the schools have the services of a full-time nurse. The examination given is a thorough one. After the preliminary weighing and measuring, the child is referred to specialists for examination of the eyes, ears, nose and throat, and to physicians for examination of the lungs and heart. Health centers are in operation where parents can bring their children for further advice.—Med. J. & Rec., March, 1925.

School Dental Services: At a recent convention of school medical inspectors, op't Eynde-Stolp presented a communication on the organization of a special dental service in the schools of Haarlem. The personnel consists of a graduate dentist and an assistant. Their equipment can be transported easily from one class to another. Pupils are not treated without the consent of their parents, which is usually given. The condition of the teeth of every pupil is entered on individual record cards, which are turned over to the school medical inspector. Of 3,000 children, 64 per cent had defective teeth.—Holland Letter, J.A.M.A., Feb. 28, 1925.

Women Dentists in Paris: The Paris correspondent of a daily newspaper reports the improved professional position and prospects of the women dentists practicing in that city. Twenty-five years ago there were but three women dentists in Paris, and these pioneers are said to have met with such an unfriendly and boycotting reception from their male colleagues that they gave up the struggle and retired to the provinces, where they had better luck. At present there are eleven women practicing as dentists in Paris, and they are all in great repute and doing well. Five of these practitioners qualified in Switzerland, two in London, and the rest in Paris.—Dent. Rec., March, 1925.

Toothache Unknown: According to the annual report of the dentist at Chase Farm Schools, Enfield, toothache is almost unknown among the 450 children living there under the care of the Edmonton Board of Guardians. No fewer than 68 per cent of them are dentally fit, and the condition of the children's teeth is said to be excellent. The schools medical officer reports that the average weight of boys and girls in the schools has increased by 10 pounds, and their height by four inches as compared with the average for 1921.—Dent. Surgeon, March 14, 1925.

Radium Institute of the Red Cross: Within the two years, 952 cancer patients presented themselves at the institute for consultation. Of this number, 742 were subjected to treatment. The surgical department treated 181 patients, ninety-six for cancer of the breast, forty for cancer of the rectum and ten for cancer of the stomach. The gynecologic section treated 221 patients with affections of the genital organs, the greatest number of them having cancer of the uterus, most of the cases being inoperable. These inoperable cases constituted about four-fifths of the total number treated, and one-third of them were cases in which the cancer was "walled in" within the small pelvis. The otorhinolaryngologic section treated 170 patients with cancers of the buccal cavity and larynx. The dermatologic section admitted 144 cases. The urologic section treated nineteen patients, the stomatologic section, six patients. The principle that in all cases dominated the technic employed was to reach the cancer by irradiations irrespective of the localization; that is, to apply "radium-surgery," or "surgery of access," so called, to all cancers no matter what the location. Radium emanations may be applied to any tumor, whether it is deeply located or simply difficult of access, and with the same accuracy of dosage as if it were a superficial cancer.—Belgium Letter, J.A.M.A., March 14, 1925.

White Bread: The Medical Officers of Schools Association has entered into the crusade against white bread. The council of the association has sent out the following circular to the headmasters of public and private schools, as the result of a general meeting held to discuss the relative values of white and stone-ground flour and bread. "The Council of the Medical Officers of Schools Association desires to urge the importance of securing for the rising generation an adequate supply of bread made from unbleached flour, from which all the important nutritive elements contained in the germ have not been removed, and asks for your earnest consideration of the following resolution passed by it as the result of the general meeting of the association and for your cooperation in putting it into effect: Whiteness of flour is not in itself an indication of its value as a food. Bread made from unbleached flour containing not less than 80 per cent of the germ is attractive, digestible and nutritious, and should be provided for the growing child."

In a letter to the Times, the president of the association, in commending these views, points out that the English are slow to change, custom dies hard, and the appeal to the eye in the matter of white bread in many people overrides all other senses and is the strongest factor in explaining the popularity of this emasculated flour. Individual voices crying in the wilderness during the last twenty or thirty years have made no apparent impression on the public at large. The president suggests that the ministry of health take a hand in this matter and insure as far as it can that this most important and universal article of diet should not be subject to abstraction (such as the removal of the germ) and addition (such as the various bleaching agents and so-called "improvers"). He considers that this plea applies with special cogency to the needs of the immature and growing child.—London Letter, J.A.M.A., Feb. 28, 1925.

GENERAL

Dr. Berger Kjellgren Returns Home: Dr. Berger Kjellgren, Scandinavian-American fellow from Stockholm, 1924-1925, who has spent four months of study

in San Diego, is returning home via San Francisco and will visit the principal dental institutions and important cities of America before sailing, in June.

Case of Hawley Vs. Erickson: In a recent suit, Justice Hoehling, of the district supreme court, refused to set aside the injunction granted Dr. C. A. Hawley preventing Dr. B. E. Erickson from practicing orthodontia in the District of Columbia until May 19, 1934. An exception is made by the court in the twenty cases in which Dr. Erickson is now engaged, and by giving bond of $4,000 he is permitted to continue treatment of these twenty cases. The court explains this exception was made in the interest of the patients. Dr. Erickson entered a contract with Dr. Hawley, in whose office and under whom he was a postgraduate student in this specialty.—Bull. Virginia Dent. Soc.

Prerequisite for Admission to Cornell: The authorities of Cornell University have made a requirement that all students admitted to the University, beginning with the fall of 1925, must be vaccinated against smallpox.—Health News, March 30, 1925.

Cooked Food Retains Some Vitamins: Cooking destroys vitamins, yet cooked foods may have adequate vitamin values. This paradox was stated before the recent annual convention of the National Canners' Association in Washington, by Prof. Walter H. Eddy of Columbia University, a widely know specialist on the subject of vitamins. Says the Daily Science News Bulletin (Washington): "Professor Eddy cited as an example the studies some years ago which indicated that ordinary cooking temperatures in an open kettle destroyed as much as 95 per cent of the anti-scorbutic vitamin, or vitamin 'C.' It was assumed, following these experiments, that cooked vegetables were entirely useless as a means of preventing scurvy and similar deficiency diseases. However, a test was later determined upon, and increased quantities of the cooked foods were fed to experimental guinea-pigs. It was discovered that even the small fraction of vitamin remaining in the cooked vegetables was sufficient to have the desired effect in the prevention of disease. This depends on the fact that vitamins are very powerful substances, and a little goes a long way. Further experiments with foods cooked in sealed containers under pressure, with air excluded, showed that the vitamin content was impaired much less than it was in open-kettle cooking. The delegates to the convention received this statement with interested comment, for canned vegetables are cooked under pressure. Professor Eddy stated that the cooking conducted in his laboratory was done in pressure cookers similar to those now used extensively in home canning. Though he encouraged his audience in the matter of the effects of cooking methods in the canneries, Professor Eddy warned them against excessive blanching of their products, saying that carried too far such processes destroy valuable vegetable sugars and salts, and have a deleterious effect on the vitamins."—Literary Digest.

Dr. Dubeau Honored: Dr. E. Dubeau, dean of the faculty of dental surgery of the University of Montreal, was recently made a knight of the Legion or Honor, the third decoration that he has received from France.

DEATHS

Sharfman, S. S., Hartford, Conn.; Harvard University Dental School, 1915, a veteran of the World War, died, March 20, in Hartford; aged 34.

Spicer, Albert H., Westerly, R. I.; Connected with the profession for sixty-four years; died in March, 1925; aged 81.

CURRENT LITERATURE

EXTRACTS AND ABSTRACTS

Drug Addiction: In a study of drug addicts in the state prisons of New York made by Abraham Kossef, chief physician of Clinton Prison (Nation's Health, January, 1925), many of the popular notions about the drug addict were shown to be unfounded on fact. The following conclusions were reached: 1. Only a small percentage of our criminals are drug addicts. 2. A smaller number are imprisoned for crimes involving the use of violence. 3. The number of drug addicts in this country is much smaller at present than has been stated by various agencies, and the number is steadily decreasing. 4. The increase in recent years in the number of drug addicts received in prison is not due to the increase in the the number of criminal addicts, but to economic conditions. 5. Drug addiction is not the result of carelessness on the part of the medical profession. 6. Our drug addicts are mostly in middle adult life and have used narcotics for four years or more. The cause of drug addiction is nearly always "association." 8. It is a medical problem demanding police supervision. 9. Treatment should be under custodial care, the criminal being segregated from the noncriminal addict. 10. Eradication of the evil will be through proper restrictive laws, and finally substitution of new preparations which are not habit forming, and the absolute discontinuance of the manufacture of our present narcotics. Dr. Kossef says, in regard to treatment: "With the method as outlined above the establishment of a normal poise is very rapid. I firmly believe that the only method of treatment is the abrupt withdrawal of the drug, and the institution of supportive treatment. Some have stated that sudden withdrawal of the drug is dangerous and cruel. I have never seen a patient die from such procedure and I believe that the memory of their misery has deterred a great many addicts from resuming the habit when released."

Dentists in Hospitals: Hospitals of standing have created positions in which the dentist works hand in hand with the attending surgeon in the preparation, performance and after-treatment of difficult operations on the jaws and palate for malignant disease, in the proper handling of injuries, fractures, etc., involving the teeth. At the Lenox Hill Hospital of this city, internists and surgeons in their ward work have long made arrangements with their dental colleagues who work in the dispensary to visit, examine and treat regularly the patients entrusted to their care; the same is done in the Children's Division. For years it has been considered indispensable to prepare the mouth (that means teeth and gums) thoroughly before performing any operation on tongue, jaws or pharynx, just as, I am sure, is customary in other leading hospitals. At the present moment our Board of Trustees is considering a proposition from the Medical Board to create a properly endowed Dental Division within the hospital. In order to do justice to the patients in the wards, some hospitals recently have commenced to have on the house staff a thoroughly trained and well-recommended young dentist, fresh from college, who attends to the regular cleansing of patients' teeth, thereby taking this time for routine work off the hands of the older and more experienced dental surgeon.—Willy Meyer, in Oral Topics, February, 1925.

Undeveloped Lower Jaw: A new treatment for this condition, called by the Germans "bird face" and by the French "serpent jaw," is given by W. T. Coughlin, (J.A.M.A., Feb. 7, 1925) who reports the case of a woman, aged 22, who had no chin and whose upper incisor teeth protruded quite beyond the lower when the jaws were closed. Only the molars (the third molars were not erupted) and second bicuspids were in proper occlusion. Gutter splints were fashioned for the upper

and lower jaw, and five operations were performed, the first involving a curved incision upward across the throat and the turning up of a flap of skin and platysma as far as the lower border of the jaw. The symphysis was divided and the bone fractured. The splints were closed drawing the fragments into position. Four months thereafter, four bone grafting operations were performed over a period of five and one-half months. Nine teeth in all were lost.

Nasal and Pharyngeal Infections: The majority of patients who have pyorrhea are subject to acidosis and indicanuria, which in turn are the causative factors in systemic infection and their eradication helps the dentist in the local treatment and the physician in dealing with the systemic conditions. The question of treatment is largely a mooted one, but I shall advance an opinion based on numerous reports of observation in such cases. First, reduce the concentration of toxins in the blood by elimination. Second, stimulate oxidation, regulate the diet and habits and give pluro-endocrines (thyroid, pituitary and gonads in small doses). Third, overcome acidosis by hyperalkalinization of the secretions; and fourth, remineralize through administration of glycerophosphate of calcium. And last, it is to be remembered that the average pyorrhea subject is one who suffers from lymphoid insufficiency and should have iodide of lime, which is the best agent we know for such a condition. Therefore, the best results come through the cooperation of the medical and dental profession.—N. H. Bowman, in Internat. J. Orthodontia.

Agranulocytic Angina: A fatal case, in a widow, aged 33, who had always been well, is reported by James H. Skiles (J.A.M.A., Jan. 31, 1925.) The onset was attended by sore throat, sore gums, chills and fever, with headache. There were large gray patches on the palate, gums and margins of many of the teeth, extremely tender and firmly adherent to the underlying tissues. There were similar patches on the cervix, vulva and anus. The temperature was 103 to 105, the pulse 100 to 120. Smears from the mouth showed Vincent's spirillum and fusiform bacilli, streptococci and staphylococci. The course of the disease was rapid. Toxic symptoms and delirium preceded death. Alkalis and sedatives were given; neo-arsphenamin was given intravenously and by mouth, and mercurochrome-220 soluble intravenously. Several cases have been reported in Germany, all in middle aged women, all of whom have shown multiple gangrenous ulcerations in the mouth, and all fatal. In the case here reported, necropsy revealed enlarged liver, spleen, right kidney and right ovary (cystic), and ulcers in the stomach and colon. The cause may be a specific infection or a primary affection of the marrow, resulting in a drop in formation of the granulocytes, with lowering of the patient's resistance.

Dentistry and Medicine: It will be noted that the view held by the American Stomatological Association is that the possession of an additional medical qualification is an advantage to those who practice dentistry, and that every effort should be made to ensure that every dentist should also be a medical man. It is interesting to compare this with the position adopted by the British Dental Association. At its annual general meeting, held in Edinburgh last summer, the British Dental Association decided to make it as difficult as possible for medically qualified dentists to become members of the Association. They did not go quite so far as definitely to exclude them from membership, but, presumably, that will be the next step. In spite, however, of this and any other similar action which the British Dental Association, in its wisdom, may see fit to take, we do not believe that serious harm will be done to British dentistry. The bond that unites dentistry with medicine is far too powerful to be broken, or even injured by such means. If the British Dental Association likes to close its doors to all who are medically qualified, clearly it has the right to do so. The result of such action will not injure these men who are excluded, nor will it seriously affect the connection between the two professions. All it will do is to weaken the Association by depriving it of some very useful members, a point which is, perhaps, of very minor importance. The British dental profession is safe enough; it is only the British Dental Association that is in danger.

Milk as a Food: Milk is more than fuel, it is food, because it has the properties that build flesh and bone. Milk contains a great deal of lime, which is needed in the body for growing bones and teeth and replacing the material worn away by wear and tear. One cup of milk contains as much lime as would be found in six eggs, in three cups of

carrots or in twelve slices of bread. One quart of milk equals more energy in food value than of any of the following: four-fifths pound of chicken, eight eggs, six pounds squash, three-fourths pound beefsteak, four and one-half pounds lobster or nine and one-half oranges. Milk is the cheapest form of animal food that a householder can buy for the money.—Bull. Indiana State Board of Health.

Present Dental Situation: In a brief review of the present dental situation in America, C. N. Johnson (Dent. Sc. J. Australia, March 2, 1925) covers the following topics:

1. Pulpless teeth. The question, while not settled, seems assured of more logical handling. The extreme position of the recent past, which resulted in the unnecessary mutilation of many mouths, is still maintained by a few medical men and dentists. There are evidences that the wave of what might almost be called fanaticism is receding. What is needed is an open mind, a careful consideration of all clinical evidence and laboratory findings, and a willingness to make haste slowly.

2. Oral hygiene. The laity are showing an ever-widening interest in this subject. Clubs, civic bodies, newspapers and other publications and the schools are spreading the gospel of the need for early and regular care of the teeth. The American Dental Association has opened a department of dental health education which serves all classes of health workers by furnishing material for teaching mouth hygiene to both children and adults. The parent learns that the deciduous teeth must be cared for if the permanent teeth are to be all that is desired. That work begins with the child is assurance that we will ultimately have a race with infinitely better teeth than those of today.

3. Prevention. This question is much in the mind of the dentist today. Progress in teaching the mass of the people the need for prophylaxis is necessarily slow, but it is to be hoped that dental disease will some day be checked as cholera, yellow fever, smallpox and diphtheria have been.

4. Cooperation between physician and dentist. The tendency is ever toward closer cooperation, the medical man and dentist consulting together to the increased welfare of the patients, and the former often appearing on the programs of the societies of the latter, and vice versa. Dentists may well acknowledge the broader vision embodied in the field of medicine, while the physician should in fairness assume that the dentist is better informed as to conditions arising in the oral cavity.

5. Community dental service. This service is broadening rapidly, with establishment of children's clinics, and only the lack of financial support is acting to limit the confines of the work. The practical educational feature of the clinic is one of the farreaching factors of this movement.

6. Dental education. Through the efforts of the Dental Educational Council, the curriculums outlined are being rigidly adhered to and entrance requirements raised. The recent amalgamation of four national educational bodies is another evidence of unification of policy.

7. Increased membership in societies and attendance at dental meetings are evidence of renewed and increased activity and interest. Study clubs are another evidence.

Industrial Hygiene in Moscow: There are eighteen tuberculosis dispensaries in Moscow which serve the districts in which they are situated. They are, of course, primarily for the workers and their families. Rykova, the wife of the Premier, who is a very able woman, took us to see an interesting one, different from any in the United States. Aside from the usual departments for the examination and treatment of cases, there is a very attractive dining room where patients come who have been prescribed extra nourishment. They are given a 2,000 calory dinner which, on the day we were there, consisted of fat soup, meat balls, rice and milk, and black bread and butter. These people are all allowed to keep on working. After dinner they go to a big open porch where they rest on cots for an hour or two. This is possible because in Moscow there is a pause of two hours in the middle of the day. About 140 persons a month take this treatment and many of them, we were told, can be discharged at the end of three months, although still under more or less medical supervision. There are also wards where other workers spend the night. They come at the end of the working-day, take a bath and leave their working clothes, and then each patient is given a clean unbleached muslin bag which contains night clothes, socks, slippers, and towels. He puts on his bed garments and a wrapper, has his supper,

and usually a lecture or a class in the evening, after which he goes to bed in a big ward with open windows, which is much more revolutionary in Moscow than one realizes till one is told that the thermometer may remain at 30 degrees below zero for weeks at a time. Everyone is well provided with clean bed linen and blankets and a great white bearskin rug. The bathroom, with tubs and showers, and the washroom were the very best I saw in Moscow. Rykova says that it is less expensive than sanatorium treatment and makes it possible for the people to keep at work. Usually the treatment lasts from two to four months. The whole building, Dispensary No. 4 it is called, is most attractive and the air very fresh, yet pleasantly warm.—Alice Hamilton and Rebecca Edith Hilles, in J. Indust. Hyg., February, 1925.

Bacterial Factor in Etiology of Caries: Fifty carious teeth were examined bacteriologically (J. Kilian Clarke, in Brit. J. Exper. Path.), and from fourteen of the larger cavities was isolated B. acidophilus-odontolyticus, described by McIntosh, James and Lazarus-Barlow. From thirty-six of the cavities the author cultured a pleomorphic acid-producing streptococcus which was predominant over the other organisms in practically all cases. It was found in pure culture in some of the smallest least exposed cavities. This organism has been named Streptococcus mutans. Sterilized teeth placed in glucose broth cultures of this acid-producing streptococcus showed erosion of the enamel and penetration of the dentinal tubules in the course of from seven to thirteen weeks, even when the culture medium was changed daily to minimize the eroding effect of the general acidity. Under the same conditions, B. acidophilus-odontolyticus caused only superficial erosions of the enamel.—Abstr. Am. J. Dis. Child.

Etiology of Dental Caries: The authors (James McIntosh, W. W. James and P. Lazarus-Barlow, in Brit. J. Exper. Path.) have isolated from a considerable proportion of cavities in carious teeth two types of an acid producing bacillus similar to Moro's B. acidophilus. Type II can produce in glucose broth cultures considerable amounts of malic and lactic acids. In such broth cultures, sterilized teeth show points of enamel erosion and occasionally invasion of the dentinal tubules by the organism when left in the tubes for many weeks with change of medium at intervals of one week. Attempts to produce caries of teeth in vivo by implanting the organisms under bands and in drilled holes have thus far not been particularly successful.—Abstr. Am. J. Dis. Child.

Bleaching Teeth by Ultraviolet Rays: Julio Betancourt (Dent. Surgeon, March 21, 1925) adds to the list of established methods of bleaching the use of the ultraviolet rays, which he has found simple, economical and successful. The filling is removed and the root treated carefully and stopped with guttapercha for two-thirds of its length. The whole surface of the dentin is then "refreshed" with a round, rose head bur, care being taken to have the remaining dentin of the same thickness throughout. Bleaching proceeds after the tooth has been completely isolated by a rubber dam. When the ray is focused on the tooth, it is bathed continuously with hydrogen peroxid. The time usually required for bleaching is from fifteen to twenty minutes. The tooth is then filled with cement and a fresh pledget of cotton moistened with hydrogen peroxid. After twenty-four hours, this filling is removed, and the permanent filling inserted, if the results are considered satisfactory. If not, a second treatment is necessary. Teeth have remained white for two years after treatment, and quite dark teeth have been restored.

Defects of School Children: The layman who ponders the matter must often be puzzled, if not dumfounded, by the large percentages of physically defective children reported by medical inspectors of schools, and he is apt to consider these findings as greatly exaggerated. The layman has his right to an opinion on the subject, for he has eyes and ears, but he is likely to be biased in his opinion toward the side of an unsafe conservatism or even nonchalance by that innate optimism regarding the high-and-mightiness of the human race which characterizes too many of us. The statement that 75 per cent of school children have physical defects may startle him a little in his smug content with the idea that we are made in the image of God, but he is too prone to remark without further investigation that the figures are false. In fact, if it were not for the inertia begot of this age-long habit of mind, he would be more active in getting something done about these defects. If he will with his own untrained sense or-

gans examine the eyes, ears, and mouths of a hundred children, he will come near agreeing with the examiner, and he may be shaken out of his lethargy on the subject by what he discovers in his own child.—School Life, February, 1925.

Orthodontia and Malnutrition: In a study of the relation of malnutrition and physical defects (W. R. P. Emerson, Boston M. & S. J., Feb. 5, 1925), it was found that, while children having carious teeth showed a greater incidence of postural defects and obstructions to breathing, there was no apparent relation between caries and malnutrition as shown by an underweight condition. Overweight children, however, were found remarkably free from carious teeth and other physical defects. Abscesses, malocclusion and more serious dental defects are a very different matter. Any interference with nutrition and growth affects the teeth, which like other tissues of the body, depend on a normal nerve and blood supply and healthy adjacent tissues for their proper growth and development. No single factor in our environment can be held accountable for abnormal dental conditions any more than for general malnutrition. The orthodontist has a part to play in dealing with the problem of malnutrition not unlike that of the specialist who corrects nasopharyngeal obstructions. Further, since the child often loses weight under the strain of dental treatment, the dentist should be able to cooperate with the physician in mapping out a course that will aid in keeping up as well as possible the child's general health during orthodontic treatment, which sometimes fails because the child's general health is poor. Orthodontic work should be undertaken only after the child's general condition is understood.

Pillowing and Malocclusions: Malocclusion, according to Harvey Stallard (Dent. Cosmos, March, 1925), has been laid to thumb or lip sucking, the eating of food requiring little chewing or the failure to chew food thoroughly. (Angle's theory is that hard chewing increases a malocclusion already existent.) Fetal environment may influence the occlusion, but most children do not show malocclusion at birth. Prenatal factors are nutrition, pathologic conditions and pressure. Their relation to various deformations should be made a matter of study. To the obvious physical factors of the postnatal environment, light, heat, humidity, air, food, infections, secretions and pressure, must be added pillowing, which affects the development not only of the face, but also of the chest, cranium, pectoral girdle and spine. Swaddling, as practiced by many primitive people, obviated these injuries, although resulting in flattening of the back of the head. Swaddling ensured that the body grew straight. Bad pillow habits have been blamed by specialists for ophthalmic disorders, nasal deformities, heart strain, spinal curvature, stooped shoulders, flattened chests, embryo displacements and pelvic constrictions. Babies are turned from side to side lest the head be flattended unduly on one side. Because of the complexity of the structure of the face, dentists marvel that it ever develops symmetrically even when development is unhampered by external forces. Ninety-five per cent of children in some American cities have malocclusion. Primitive peoples, certain Europeans and apes have a high percentage of normal occlusion. Complexity is not necessarily an antecedent of abnormality, but a complex organ in unfavorable surroundings is more apt to be deformed than a simple one. Since so much time is spent by the infant in sleeping, there is every chance for malocclusion to develop from the pressure of the pillow on the soft, complex developing denture. It matters not whether the child eats soft or hard foods, is healthy or suffers from rickets, tuberculosis or syphilis, deformity must result from bad pillow habits. Of course, in ill health, the damage will probably be greater. Pillow habits may inhibit or overstimulate denture growth in each of three directions. Face pillowers suffer most severely. We have had no training to teach us how to sleep without injuring our bodies. Exercise, fresh air and good food fail to insure against misshapen faces and bad posture. "Pillow habits produce the chief deformations of the jaws. By teaching correct pillow habits, we may not prevent all malocclusions but we will prevent many of the terrible jaw deformities and the general body deformations that accompany them. The desire to improve uniformly the postures of American men can probably never be fulfilled until children are taught to lie straight in bed, in the direction in which they should grow."

Deformities of the Jaws: In an effort to prevent malocclusion, Harris W. McClain (Chicago Dent. Soc. Bull., Feb. 20, 1925) suggests that: 1. Infants should be placed upon flat hair mattresses, with

small if any pillows, in such a position that the weight of the head does not rest upon the face. Placing a baby on its stomach to relieve colic may produce a pillowing habit which will result in deformed jaws. 2. Bottle feeding not only deprives the child of the exercise for the jaws which natural sucking provides but conduces to nipple habits which later manifest themselves in malocclusion. 3. Pernicious nervous habits should be watched for and broken up. Often the substitution of a positive action is better than negative admonition. 4. It is important that every child should have something in its daily diet which requires chewing. Nature provides teeth during the first years of life for a purpose and, like other organs, the masticating mechanism requires use for its development. 5. Mouth breathing is a habit and remains after adenoids and other nasal obstructions have been removed unless positive measures are taken to correct it. 6. The premature loss in part or in whole of the baby teeth allows the other teeth to move out of their normal position and upset the whole plan of occlusion. 7. The sixth year molars are permanent teeth. They should be watched for and examined two or three times a year from the time they erupt. 8. Much of the health and happiness of the individual depends on the care or neglect of his teeth in childhood. Deformities of the jaws are the beginnings of many of the dental ills, whose sequelae are infections in other parts arising from foci located in the supporting structures surrounding the teeth.

Food Value of Milk: Milk is unique in furnishing more calcium than any other common food. The studies of Sherman and Hawley have shown significantly that on an ordinary diet containing daily 750 grams of milk and furnishing a total of from 0.74 to 1.02 grams of calcium a day, children from three to thirteen years of age secured from 0.15 to 0.62 grams of calcium a day, the amount being approximately proportional to the size of the child and averaging 0.01 grams of calcium per kilogram of body weight daily. When the daily allowance of milk was increased to 1,000 grams, the storage of calcium was increased. The results obtained indicate that optimal storage of calcium is made when the diet contains one quart of milk a day for each child. Various reports of committees on nutrition give ample evidence that the benefit of a liberal allowance of milk is not due to the calcium alone but to its well balanced proportions of calcium, phosphorus and other growth essentials. It is an interesting fact that some of the earliest fundamental observations which led to the appreciation of those essential dietary factors now designated as vitamines were made in relation to milk and its derivations.—Nation's Health, March, 1925.

Psicaine: One of the latest of the many synthetic substitutes for cocaine is psicaine, an optically active isomer of cocaine which has been prepared by Willstater in collaboration with the firm of E. Merck, of Darmstadt. Two articles on this drug appeared in the British Medical Journal for January 3, by A. J. Copeland and E. Watson-Williams. Although German writers state that psicaine has double the anaesthetic properties of cocaine but only half its toxicity, this is not borne out by the experiments of Copeland. He finds that on the cornea psicaine has only one-sixteenth the anaesthetic power of cocaine. The minimal effective concentrations for complete anaesthesia after instillation are—for cocaine 0.25 per cent, and for psicaine 2.5 per cent. The effect of psicaine on the vagus and on sensory nerves is weak as compared with cocaine. Copeland has determined the minimal lethal dose of these drugs on rabbits, guinea-pigs and mice. The actual toxicity of psicaine as compared with cocaine is only slightly less in all these animals, and contrasts very unfavorably with novocain. Copeland does not consider that the claims for efficiency and low toxicity which have been made for psicaine are justified, and that this drug is unlikely to prove a satisfactory substitute for cocaine. E. Watson-Williams comes to very similar conclusions, and considers that psicaine must be considered as a dangerous drug, to be used with caution.—Brit. Dent., Jour., March 16, 1925.

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Harold DeWitt Cross, 140 The Fenway, Boston, Mass.
Charles H. Oakman, 1247 David Whitney Building, Detroit, Michigan.

Secretaries:
Guy S. Millberry, First & Parnassus Aves., San Francisco, Calif.
E. L. Pettibone, 6503 Detroit Ave., Cleveland, Ohio.

Section XII
DENTAL EDUCATION
Officers of Section

President:
Thomas J. Barrett, 507 Main St., Worcester, Mass.

Honorary Presidents:
Nelville S. Hoff, Ann Arbor, Mich.
Eugene H. Smith, 283 Dartmouth St., Boston, Mass.
John H. Kennerly, St. Louis, Missouri.

Vice-Presidents:
F. T. Breene, University of Iowa, Iowa City, Iowa.
Alfred Owre, University of Minnesota, College of Dentistry, Minneapolis, Minn.
William Rice, Tufts College, 416 Huntington Avenue, Boston, Mass.

Secretaries:
DeLos L. Hill, 12 W. 11th Street, Atlanta, Ga.
F. R. Henshaw, 904 Medical Arts Bldg., Indianapolis, Indiana.

Section XIII
DENTAL LEGISLATION
Officers of Section

President:
R. J. Rinehart, 4091 Bryant Building, Kansas City, Mo.

Honorary Presidents:
Albert L. Midgley, 315 Butler Exchange, Providence, R. I.
Homer C. Brown, 609 Hartman Building, Columbus, Ohio.
T. A. Broadbent, 25 E. Washington St., Chicago, Illinois.

Vice-Presidents:
G. Walter Dittmar, 59 E. Madison St., Chicago, Illinois.
Frank O. Hetrick, Ottawa, Kansas.
J. H. Baldwin, 908 Francis Building, Louisville, Ky.

Secretaries:
H. C. McKittrick, 1006 I. O. O. F. Building, Indianapolis, Indiana.
W. F. Walz, 159 E. Main Street, Lexington, Kentucky.

Section XIV
MILITARY SURGERY
Officers of Section

President:
Robert T. Oliver, Army Bldg., New York, N. Y.

Honorary Presidents:
Emory A. Bryant, U. S. Naval Hospital, Charleston, S. C.
James P. Harper, St. Louis Dental College, St. Louis, Missouri.
W. A. Heckard, 311 W. 91st St., New York, N. Y.

Vice-Presidents:
Rex Rhoades, Surgeon General's Office, War Department, 725 Munition Bldg., Washington, D. C.
H. E. Harvey, Navy Department, Washington, D. C.
C. W. Mills, Chillicothe, Ohio.

Secretaries:
John L. Peters, 133 W. 72nd St., New York, N. Y.
Lucien C. Williams, Bureau of Medicine & Surgery, Navy Department, Washington, D. C.

RULES OF THE SEVENTH INTERNATIONAL DENTAL CONGRESS

ARTICLE 1

The Seventh International Dental Congress will be held in Philadelphia, Pennsylvania, United States of America, at the Commercial Museum and .....
under the patronage of .....

ARTICLE 2

The Congress will be opened with a General Meeting on Monday morning, August 23, 1926, at ten o'clock, and will close with a General Meeting on Friday evening, August 28, 1926, at eight o'clock.

ARTICLE 3

The object of the Congress is the advancement of dental science in its relation to public health.

ARTICLE 4

Membership in the Congress.

(a) *Active Membership.*—An ethical practitioner of dentistry possessing the qualifications of the country in which he received his professional education, or of the country in which he practices, is eligible for membership in the Congress through either of the following methods:

1. By the payment of an individual membership fee of $10.00.
2. By an accredited national dental association joining the Congress as a body in behalf of all its members, and paying from its treasury a fee of $1.00 per member for its total membership.

(b) *Associate Membership.*—Medical men and members of other scientific professions who have paid the individual membership fee of $10.00 are associate members.

(c) *Honorary Membership.*—The Committee of Organization may elect Honorary Members of the Congress.

All applications for admission to membership of the Congress must come before the Committee of Organization (or such subcommittee as may be authorized) for approval, which, in the case of foreign applicants, will act in conjunction with the official representatives of the National Committee of their respective countries as occasion requires.

ARTICLE 5

Visitors to the Congress Not Eligible for Membership.—Members may introduce members of their families as visitors to the Congress upon payment of a fee of $5.00.

Other visitors may be admitted to the Congress upon the nomination of members upon payment of the membership fee of $10.00.

Dental students vouched for by the Deans or

other executive officers of recognized dental schools may be admitted as visitors upon the payment of a fee of $5.00.

Dental practitioners residing in the United States of America are not eligible for admission to the Congress either as members or visitors unless they hold membership in the American Dental Association.

The names of all visitors must be submitted to and approved by the Committee of Organization, or such subcommittee as may be authorized.

ARTICLE 6

Membership Fees should be sent by postal order, draft, or check, payable to the SECRETARY GENERAL, 7th INTERNATIONAL DENTAL CONGRESS, 58 EAST WASHINGTON STREET, CHICAGO, ILLINOIS, U. S. A. A formal receipt, in the form of a membership card to the Congress, will be sent upon payment of the membership fee. Admission to the Congress will be granted only upon presentation of such a card.

ARTICLE 7

The Secretary General shall receive all moneys due from membership fees and from all other sources, and shall pay the same to the Treasurer of the Congress, who shall keep all moneys and pay out same only on written order of the President and Secretary General of the Congress. The Secretary General and Treasurer each shall give a bond in amount specified by the Executive Committee at the expense of the Congress.

ARTICLE 8

No one can be enrolled as a member of the Congress prior to the receipt of his membership fee.

An applicant when sending his membership fee should enclose his card, indicating thereon his dental or medical qualifications, titles, names of dental and medical societies in which he holds membership, and his full postal address. The Secretary General should immediately be notified of any change of address.

ARTICLE 9

Members of the Congress will receive the Official Program and the Catalog of the Exhibits gratis.

The Transactions of the Congress will be furnished, at cost, to such members as order them, on official forms provided for that purpose, previous to the close of the Congress.

ARTICLE 10

The organization of the Congress is in charge of the Committee of Organization appointed under Article 16 of the Fédération Dentaire Internationale, or Permanent Bureau of International Dental Congresses.

ARTICLE 11

The scientific work of the Congress will be presented in

(a) General meetings
(b) Meetings of Sections
(c) Clinics
(d) Scientific Exhibits

The amount of time allotted to each of the above subdivisions and to the Speakers at the General Meetings will be determined by the Executive Committee.

ARTICLE 12

The Congress will hold an Opening General Meeting on Monday morning, August 23, 1926, at ten o'clock, and a Closing General Meeting on Friday evening, August 28, 1926, at eight o'clock.

There will be no debates at those meetings. At the Closing Meeting, the President will submit the reconstruction of the Fédération Dentaire Internationale to a vote, and if approved, the next order of business shall be the determination of the place and date of the next Congress.

ARTICLE 13

Sections of the Congress

1. Anatomy, Physiology, Materia Medica and Therapeutics.
2. Bacteriology, Pathology and Diagnosis.
3. Physics, Chemistry and Metallurgy.
4. Operative Dentistry.
5. Partial Denture Prosthesis (including Crown and Bridge Work).
6. Full Denture Prosthesis.
7. Exodontia, Anesthesia and Roentgenology.
8. Orthodontia.
9. Maxillo-Facial Surgery and Surgical Prosthesis.
10. Periodontia.
11. Mouth Hygiene, Preventive Dentistry and Public Health.
12. Dental Education.
13. Dental Legislation.
14. Military Surgery.

Sections may hold combined meetings with the approval of the Committee of Organization (or such subcommittee as may be authorized).

ARTICLE 14

English, French, German and Spanish will be the official languages of the Congress. Other languages may be used with the consent of the President.

ARTICLE 15

The Transactions of the Congress will be published under the authority of the Committee of Organization. The speeches delivered at the opening and closing general meetings, as well as the reports (see Article 18) will be published in full. The papers and speeches of individual members, and the reports of the clinics, will be published in such form as the Publication Committee, after receiving recommendations from the sectional officers, may decide.

ARTICLE 16

Voluntary Papers and Clinics.—All those who wish to read papers or give clinics must notify the Secretary of the appropriate section before March 1, 1926. The officers of a section have the right of selection from among the papers and clinics volunteered, and of declining any they do not desire. Notices sent in after July 1, 1926, can be considered only after the program has been arranged, subject to the right of selection by the President of a section.

The Executive Committee of the Committee on Organization is granted authority to give or withhold their final approval of all papers, reports and clinics submitted to them by the officers of sections or the Clinic Committee.

ARTICLE 17

Papers may be written in English, French, German or Spanish. They must be delivered to the Secretary of the Section before which they are to be read, in typewritten form ready for printing. An abstract or summary of the important points of the papers must reach the Secretary of the Section before July 1, 1926. Notices of clinics must include a list of the clinician's requirements and must be received before July 1, 1926.

A maximum of fifteen minutes will be allowed for the reading of a paper, and five minutes for each speaker taking part in the discussion. The author will be allowed five minutes for a reply.

ARTICLE 18

*Reports.***—In each section time will be reserved for the discussion of important questions, which have previously been selected by the officers of the section, with due regard to the international character of the Congress. Each discussion will be introduced by two or more reporters chosen by the officers of the section. The manuscripts of these reports must be typewritten and must be sent to the office of the Congress before July 1, 1926, in order that they may be printed for distribution.

Each reporter will be allowed a maximum of fifteen minutes for an opening résumé, and ten minutes for a reply at the end of the discussion. Other speakers taking part in the discussion will be allowed a maximum of five minutes.

**A report is a written presentation on an assigned subject given by two or more members who have been selected by the officers of the section before which it is to be presented.

ARTICLE 19

Copyright of communications made to the Congress becomes thereby the property of the Committee of Organization of the Congress.

ARTICLE 20

The meetings will be conducted according to the Rules of Debate adopted for this Congress, but no vote may be taken, nor any resolution passed upon a scientific question. Any resolution that may, with the President's consent first obtained, be passed upon a question of a practical or administrative character, shall forthwith be transmitted to the Secretary General, who shall submit the same to the Committee of organization of the Seventh International Dental Congress in conjunction with the members of the Executive Council of the Fédération Dentaire Internationale as constituted at its last annual meeting previous to the convening of the Seventh International Dental Congress.

ARTICLE 21

A speaker who desires his remarks in the course of discussion to be published in the transactions of the Congress must send a brief résumé in writing to the Secretary of the section before the end of the meeting. (Special note sheets will be provided for this purpose by the secretaries.)

ARTICLE 22

All moneys left in the treasury, after the payment of all financial obligations, shall be disbursed as follows:

1. Two-fourths to the treasury of such national accredited dental association which joined the Congress as a body. If a number of national associations join as units, the two-fourths shall be distributed to each Association with due regard to the total membership of each.

2. One-fourth to the treasurer of the Fédération Dentaire Internationale.

3. The final fourth to be retained by the Treasurer of the Seventh International Dental Congress until officially advised of the name of the Treasurer of the Eighth International Dental Congress, at which time the balance shall be transferred to said treasurer.

4. In the instance no national association joins the Congress as a unit, all moneys left in the treasury shall be disbursed as follows: three-fourths to the treasury of the Fédération Dentaire Internationale, and one-fourth to the Treasury of the Eighth International Dental Congress on the conditions herein before named.

ARTICLE 23

All correspondence should be addressed to the Office of the Congress as follows:

The Hon. Secretary General,
7th International Dental Congress,
58 E. Washington Street,
Chicago, Illinois, U. S. A.

RULES OF DEBATE OF THE SEVENTH INTERNATIONAL DENTAL CONGRESS

1. The President of a section, or in his absence or by his desire, one of the Vice Presidents, or an Honorary President, having taken the Chair, the subject before the meeting shall be announced, and the presiding officer shall call upon the reader of a paper, or a reporter in debate, or other speaker, to address the meeting.

2. During the meeting the presiding officer shall maintain order in the proceedings. All questions of procedure must be referred to him, and his decision shall be considered final.

3. Members, before speaking, must give their names in writing to the presiding officers.

4. Members desiring to take part in a discussion may inform one of the secretaries beforehand, who shall enter their names upon a list in order received for the use of the presiding officer.

5. The presiding officer will intimate to any member who may be addressing the meeting the termination of the period of his time allowance under the Rules (see Articles 17 and 18).

Announcements

CALENDAR OF MEETINGS

NATIONAL SOCIETIES

American Academy of Periodontology, Louisville, Kentucky, September 17-19, 1925.

American Dental Assistants' Association, September 21-25, 1925, Louisville, Kentucky.

American Dental Association, September 21-25, 1925, Louisville, Kentucky.

American Dental Society of Europe, July 28-31, London.

American Medical Association, May 25-29, 1925, Atlantic City, New Jersey.

American Society of Oral Surgeons and Exodontists, September 18-19, 1925, Louisville, Kentucky.

Fédération Dentaire Internationale, August 2-6, 1925, Geneva, Switzerland.

Pacific Coast Dental Conference, 1926, Portland, Oregon.

Seventh International Dental Congress, August 23-28, 1926, Philadelphia, Pennsylvania.

STATE SOCIETIES

District of Columbia, at George Washington University, Washington, D. C., second and fourth Tuesdays in each month from October to June inclusive.

National Capital at Washington, D. C., first Tuesday of every month.

May (1925)

California, at Oakland (25-28).
Illinois, at Peoria (12-14).
Indiana, at Indianapolis (18-21).
Iowa, at Des Moines (5-7).
Maryland, at Baltimore (4-6).
Massachusetts, at Boston (4-8).
Mississippi, at Jackson (19-21).
Missouri, at Kansas City (11-13).
Nebraska, at Omaha (18-21).
New York, at Albany (13-15).
North Carolina, at Pinehurst (12-14).
North Dakota, at Fargo (5-7).
Pennsylvania, at Reading (5-7).
Tennessee, at Knoxville (5-7).
Texas, at San Antonio (19-22).
West Virginia, at Beckley (18-20).

June (1925)

Colorado, at Colorado Springs (18-20).
Georgia, at Augusta (10-12).
Maine, at Bangor (25-27).
New Hampshire, at Manchester (10-12).
New Mexico, at Albuquerque (22-24).
Oregon, at Portland (3-6).
South Carolina, at Columbia (17-19).
South Dakota, at Watertown (11-13).
Southern California, at Los Angeles (29-30, July 1-2).
Utah, at Salt Lake City.
Washington, at Spokane (1).
Wyoming, at Buffalo (29-30).

July (1925)

Porto Rico, at San Juan (5-6).
Rhode Island, at Newport.
Wisconsin, at Madison (14-16).

September (1925)

Kentucky, at Louisville (18-19).

October (1925)

Florida, at Orlando.
New England, at Boston, Mass. (15-17).

December (1925)

Nevada, at Reno (5).
Ohio, at Columbus (1-3).

February (1926)

Minnesota, at St. Paul (10-12).

MEETINGS OF THE STATE BOARD OF DENTAL EXAMINERS

Alabama, at Tuscaloosa, commencing June 22, 1925, Secretary, E. W. Patton, Selma, Alabama.

Arkansas, at Little Rock, June 22-24, 1925. Secretary, W. E. Hutchinson, Dermott, Arkansas.

California, at San Francisco, May 9, 1925 and at Los Angeles, June 13, 1925. Secretary, O. E. Jackson, Petaluma, California.

Connecticut, at Hartford, June 25-27, 1925. Recorder, Arthur B. Holmes, Waterbury, Connecticut.

Delaware, at Wilmington, June 17-18, 1925. Secretary, W. S. P. Combs, Middletown, Delaware.

District of Columbia, at Washington, June 15-19, 1925. Secretary, C. Willard Camalier, Washington, D. C.

Florida, at Jacksonville, June 24, 1925. Secretary, R. P. Taylor, 414 St. James Bldg., Jacksonville, Florida.

Indiana, at Indianapolis, June 8-13, 1925. Secretary, H. C. McKittrick, 502 I. O. O. F. Bldg., Indianapolis, Indiana.

Iowa, at Iowa City, June 1, 1925. Director, H. W. Grefe, Des Moines, Iowa.

Kansas, at Wichita, June 15, 1925. Secretary, George E. Burket, Kingman, Kansas.

Kentucky, at Louisville, June 2, 1925. Secretary, J. H. Baldwin, 908 Francis Building, Louisville, Kentucky.

Maine, at Augusta, June 29-July 1. Secretary, G. W. MacKay, Millinocket, Maine.

Maryland, at Baltimore, June 2-4, 1925. Secretary, T. L. McCarriar, 1822 North Charles Street, Baltimore, Maryland.

Massachusetts, at Boston, June 16-20, 1925. Secretary, J. N. Carriere, Room 146, State House, Boston, Massachusetts.

Michigan, at Ann Arbor, June 8-13, 1925. Secretary, J. W. Lyons, 617-19 Dwight Bldg., Jackson, Michigan.

Missouri, at St. Louis, June 10-13, 1925. Secretary, George E. Haigh, Jefferson City, Missouri.

National Association of Dental Examiners, at Louisville, Kentucky, September 21-22, 1925. President, G. L. Powers, Memphis, Tennessee.

Nevada, at Reno, May 13, 1925. Secretary, G. H. Marvin, P. O. Box 56, Reno, Nevada.

New Jersey, at Trenton, June 29-July 3, 1925. Secretary, John C. Forsyth, 429 E. State St., Trenton, New Jersey.

North Carolina, at Raleigh, June 15, 1925. Secretary, F. L. Hunt, Asheville, North Carolina.

North Dakota, July 14, 1925. Secretary, W. E. Hocking, Devils Lake, North Dakota.

Oklahoma, at Oklahoma City, June 22, 1925. Secretary, L. M. Doss, American National Bank Building, Oklahoma City, Oklahoma.

Pennsylvania, at Philadelphia and Pittsburgh, June 17-20, 1925. Secretary, Alexander H. Reynolds, 4630 Chester Avenue, Philadelphia, Pennsylvania.

Rhode Island, at Providence, June 23-25, 1925. Secretary, Albert L. Midgley, 315 Butler Exchange, Providence.

South Carolina, at Columbia, June 15-18, 1925. Secretary, W. K. Walker, Orangeburg, South Carolina.

South Dakota, at Sioux Falls, June 17-19, 1925. Secretary, G. G. Kimball, Mitchell, South Dakota.

Tennessee, at Nashville, June 15, 1925. Secretary-Treasurer, F. W. Meacham, 911 Hamilton National Bank Building, Chattanooga, Tennessee.

Texas, at Dallas, June 8-11, 1925. Secretary, R. L. Rodgers, Amarillo, Texas.

INDIANA STATE DENTAL ASSOCIATION

The sixty-seventh annual meeting of the Indiana State Dental Association will be held in the Claypool Hotel, Indianapolis, Indiana, May 18, 19, 20 and 21, 1925. A complete program has been arranged to start Monday morning at 10:00 o'clock continuing until Thursday noon.

All ethical members are invited.

C. L. Byers, *Secretary*,
2138 N. Illinois St.,
Indianapolis, Indiana.

MARYLAND STATE DENTAL ASSOCIATION

The annual meeting of the Maryland State Dental Association will be held in Baltimore, May 3-5, 1926.

Norval H. McDonald, *Secretary*,
304 Morris, Bldg.,
Baltimore, Md.

NEW ENGLAND DENTAL SOCIETY

The New England Dental Society will hold its thirty-first annual meeting in Boston, Mass., Oct. 15-17, 1925, at the Harvard University Dental School.

Alvin A. Hunt, *Secretary*,
902 Main St.,
Hartford, Conn.

DENTAL ASSOCIATION OF PORTO RICO

The next annual meeting of the Dental Association of Porto Rico will be held in San Juan, July 5-6, 1925.

J. Hernandez, *Secretary*,
San Juan, P. R.

WYOMING STATE DENTAL ASSOCIATION

The Wyoming State Dental Association will hold its tenth annual meeting in Buffalo, June 29-30.

E. C. Andrew, *Secretary*,
Cheyenne.

DELAWARE STATE BOARD OF DENTAL EXAMINERS

The next meeting of the Delaware State Board of Dental Examiners will be held in the Municipal Building, Tenth and King Sts., Wilmington, June 17 and 18, 1925, 9:00 A. M. to 5:00 P. M. For further information address

W. S. P. COMBS, *Secretary,*
Middletown, Del.

MARYLAND BOARD OF DENTAL EXAMINERS

The regular semi-annual meeting of the Maryland State Board of Dental Examiners will be held on Tuesday, Wednesday and Thursday, June 2, 3, 4, 1925, at the Dental Department of the University of Maryland, Lombard and Greene Sts., Baltimore, Maryland. For further information and application blanks, address

T. L. MCCARRIAR, *Secretary,*
1822 North Charles St.,
Baltimore, Md.

MASSACHUSETTS BOARD OF DENTAL EXAMINERS

The Massachusetts Board of Dental Examiners will hold an examination for registration for both dentists and oral hygienists in Boston, June 16-20, 1925. Full information, application blanks, etc., may be secured at the office of the secretary. All applications must be filed at the office of the secretary at least ten days before date set for examination.

J. N. CARRIERE, *Secretary,*
Room 146, State House,
Boston, Mass.

MICHIGAN STATE BOARD OF DENTAL EXAMINERS

The Michigan State Board of Dental Examiners will hold its next examination at the Dental College, University of Michigan, Ann Arbor, June 8-13, 1925. The examination begins at 8 A. M. For information and application blanks, address

J. W. LYONS, *Secretary,*
617-19 Dwight Bldg.,
Jackson, Mich.

MISSOURI DENTAL BOARD

The next meeting of the Missouri Dental Board will be held in St. Louis, June 10-13, 1925. For further information, address

GEORGE E. HAIGH, *Secretary,*
Jefferson City, Mo.

NATIONAL ASSOCIATION OF DENTAL EXAMINERS

The National Association of Dental Examiners will meet, Sept. 21-22, 1925, in Louisville, Ky.

G. L. POWERS, *President,*
Memphis, Tenn.

NORTH CAROLINA STATE BOARD OF DENTAL EXAMINERS

The next meeting of the North Carolina State Board of Dental Examiners will be held at Raleigh, N. C., beginning promptly at 9 A. M., June 15, 1925. For further information and application blanks, address

F. L. HUNT, *Secretary,*
Asheville, N. C.

RHODE ISLAND BOARD OF REGISTRATION IN DENTISTRY

A meeting of the Rhode Island Board of Registration in Dentistry for the examination of candidates will be held at the State House, Providence, June 23-25, 1925, beginning each day at 9 A. M. Candidates shall present to the secretary of this board, at least one week before the examination, a written application on a form provided by the board, together with the examination fee of $20.00.

ALBERT L. MIDGLEY, *Secretary,*
315 Butler Exchange,
Providence, R. I.

SOUTH CAROLINA STATE BOARD OF DENTAL EXAMINERS

The South Carolina State Board of Dental Examiners will hold its next regular meeting in Columbia, at the Jefferson Hotel, June 15-18, 1925. All applications must be filed with the secretary ten days before the examination. For application blanks and further information, address

W. K. WALKER, *Secretary,*
Orangeburg, S. C.

TENNESSEE BOARD OF DENTAL EXAMINERS

The Tennessee Board of Dental Examiners will meet at 10:00 A. M., June 15, 1925, at Dental Department, Vanderbilt University, Nashville, Tennessee, for the purpose of examining all applicants who present credentials acceptable to the Board of Dental Examiners. (Hygienists will also be examined.) Bring credentials to Board meeting for examination. Applications should be in the hands of the Sec-

retary five days before the Board meeting. For applications and clinical requirements, address

F. W. MEACHAM, *Secretary-Treasurer,*
911 Hamilton National Bank Bldg.,
Chattanooga, Tenn.

MASSACHUSETTS DENTAL HYGIENISTS' ASSOCIATION

The fourth annual meeting of the Massachusetts Dental Hygienists' Association will be held at the Copley Plaza, Boston, May 4-8, 1925. A cordial invitation is extended to dentists and dental hygienists to attend the meeting.

CONNECTICUT STATE DENTAL HYGIENISTS' ASSOCIATION

The eleventh annual meeting of the Connecticut State Dental Hygienists' Association will be held, Friday, May 8, 1925, at the Stratfield Hotel, Bridgeport, Conn. Dr. Hermann Prinz of the University of Pennsylvania will be the luncheon speaker.

AMERICAN SOCIETY OF ORAL SURGEONS AND EXODONTISTS

The seventh annual meeting of the American Society of Oral Surgeons and Exodontists will be held at the Brown Hotel in Louisville, Ky., Sept. 18-19, 1925, the Friday and Saturday preceding the annual session of the American Dental Association.

EARLE H. THOMAS, *Secretary,*
30 North Michigan Ave.,
Chicago, Ill.

LIBRARY EXTENSION BUREAU

In order that the library of Northwestern University Dental School may serve the largest possible number, the services of an abstractor have been made available to the entire dental profession. Indexes now being published by the Dental Index Bureau are available for this work. Dentists who are writing papers or who wish to study the literature of a particular subject can secure selected lists of articles at nominal rates, which will be supplied on application. Study clubs and members of the American Dental Association will be supplied with lists of articles on any subject, and, under certain conditions, books and journals will be sent from the Library at the cost of postage.

This work is in charge of Dr. William Bebb, to whom all communications should be addressed, in care of the Northwestern University Dental School, 31 West Lake St., Chicago.

ATTENTION WOMEN DENTISTS

In an effort to compile a history of women in dentistry, Dr. Vida A. Latham, 1644 Morse Ave., Chicago, spent last year in collecting data, which was read at the meeting of the Federation of Women Dentists in Dallas last fall. Lately, she has sent out a letter asking for the history of dental sororities or the names of women who practiced in the nineteeth century. Anyone furnishing such information to Dr. Latham will merit the gratitude of the women of the profession. Such delightful times are being enjoyed at the yearly meeting of the Federation of Women Dentists that we hope every woman in practice in America will make an effort to join and attend the Louisville meeting.

M. EVANGELINE JORDON,
Los Angeles, Calif.

INFORMATION RELATING TO THE GRANTING OF LICENSES TO PRACTICE DENTISTRY IN THE STATE OF ARIZONA

1. There is no provision for the granting of temporary licenses.

2. No one is exempt from taking an examination before the Arizona Board of Dental Examiners.

3. Candidates for examination must: (a) have been duly licensed to practice dentistry elsewhere in the United States; or (b) have a diploma from some reputable dental college or dental department of a University. Candidates should bring with them, for inspection by the Board, such license or diploma.

4. Examinations are held at least once, but not more than twice, in each year. The next examination will be held at Phoenix, Arizona, beginning June 22, 1925.

5. Examination fee of $25.00 and sworn statement of candidate's qualifications on a blank furnished by the Secretary of State of Arizona should be in the hands of the Secretary of State, at least twenty days before the examination.

6. The theoretical examination will cover the following subjects: general anatomy, dental anatomy, histology, physiology, general pathology, dental pathology, bacteriology, oral hygiene, oral surgery, chemistry, metallurgy, dental medicine, anesthetics, mechanical dentistry, operative dentistry and orthodontia.

7. The practical examination consists of demonstrations of the candidate's skill in operative and mechanical dentistry. Candidates should bring all necessary instruments and materials, as the Board will furnish only chairs, tables, towels and plaster of Paris.

EUGENE MCGUIRE, *Secretary,*
102 Physicians Bldg., Phoenix.

NEW BOOKS RECEIVED FOR THE LIBRARY OF THE JOURNAL OF THE AMERICAN DENTAL ASSOCIATION

The Journal of the American Dental Association promptly acknowledges herewith the receipt of new publications. Books selected from those named on this list are reviewed below. Reviews are matter-of-fact statements of the nature and contents of the publication referred to and are intended *solely to guide possible purchasers.*

Operative Dentistry for Children, A Textbook Dealing with the Prophylactic and Curative Treatment of the Teeth of the Child, Based upon Experiences Gained During More Than Twenty-Five Years Devoted to the Care of Children Exclusively. By M. Evangeline Jordon, D.D.S., Los Angeles and San Francisco, Calif. Brooklyn, Dental Items of Interest Publishing Co.; London, Claudius Ash, Son & Co., 1925. 182 pages; 158 illustrations.

The Modern Practice of Tooth-Extraction. By Lester Richard Cahn, D.D.S., New York. The Macmillan Company, 1924. Illustrated. 132 pages.

According to the preface, this book is intended primarily for the general practitioner and student. The extraction of impacted and unerupted teeth has been omitted as the author considers their removal a surgical operation, and the text is written for the general practitioner. Preoperative and postoperative care are emphasized.

The Technic of Local Anesthesia. By Arthur E. Hertzler, A.M., M.D., Ph.D., LL.D., F.A.C.S., Professor of Surgery in the University of Kansas; Surgeon to the Halstead Hospital, Halstead, Kansas; to St. Luke's Hospital and St. Mary's Hospital, Kansas City, Mo.; and to the Providence Hospital, Kansas City, Kan.; St. Louis, The C. V. Mosby Company, 1925; Third Edition. 272 pages. 140 illustrations. Price, $5.50.

Chapters I, "Drugs Employed," II, "Technic of Administration," III, "General Operations," and V, "Operations of Face, Jaw and Tongue," will be of especial interest to dentists.

The Dentist's Own Book, A Faithful Account of the Experience Gained During Forty-Six Years of Dental Practice—Including a Complete Bookkeeping and Recording System, and a Description of the Management of a Dental Practice. By C. Edmund Kells, D.D.S.: St. Louis, The C. V. Mosby Company. 510 pages. 116 illustrations.

PATENTS OF INTEREST TO DENTISTS

1445290. Means for causing registration of roentgenographs, Arthur W. Buck, St. Louis, Mo.

1445385. Centrifugal casting machine, Leon Cammen, Tuckahoe, N. Y.

1445499. Dental tray, Samuel E. Douglass, Raleigh, N. C.

1445009. Holder for dental floss, Eldon W. Eby, Blenheim, Canada.

1445351. Tooth-cleaning preparation, Carl Pfanstiehl, Highland Park, Ill.

1445352. Tooth-cleaning preparation, Carl Pfanstiehl, Highland Park, Ill.

1445169. Dental film holder, Henry W. Ralph, Edenton, N. C.

1445641. Making hypodermic syringes, Frank X. Nowak, Brooklyn, N. Y.

1446742. Stress-precluding attachment for artificial dentures, Arthur Feinberg, New York, N. Y.

1447020. Saliva ejector, Josef Grunberg, Berlin Germany.

1446906. Dental tool, Wm. A. Kelsey, Minneapolis, Minn.

1446921. Bur stand, C. F. Montag, Blue Island, Ill.

1446520. Receptacles for toothbrushes, Ashley W. Smith, London, England.

1447646. Selenium cell or bridge. Carl W. Cherry, Boston, Mass.

1447209. Ether dropper, Isaac E. Hill, Hannibal, Mo.

1447399. Device and method of making stereoscopic X-ray pictures, Louis W. Pease, Chicago, Ill.

1447571. Burner, Zerne O. Rarick, Toledo, Ohio.

1447430. Screen for X-ray photography, George W. Richardson, Chicago, Ill.

1448456. X-ray plate, Leonard A. Levy and A. L. Landau, London, England.

1448231. Toothbrush container, Benjamin R. Morrison, Wilmington, N. C.

1448170. Broach. A. J. Utzinger, Plainfield, N. J.

1449318. Dental chart and making the same, Gilbert D. Fish, Washington, D. C.

1449154. Alloy, Calvin S. Videon, Tottenville, N. Y.

1449357. Filter indicator for X-ray system, Harry F. White, New York, N. Y.

1449631. Removable bridgework attachment, Isidore Stern, New York, N. Y.

1449079. Vertically-split attachment for removable bridgework, John Yirikian, New York, N. Y.

Copies of above patents may be obtained for twenty-five cents each, by addressing John A. Saul, Solicitor of Patents, Federal Building, Washington, D. C.

Which---the Go-Getter or the Sales-Statesman?

By Ernest V. Madison

ONE of the colloquial terms of the day, widely used in salesology, is the "Go-getter."

A "Go-getter" is defined, in current slang, as one who "brings home the bacon;" or specifically to those of us who buy, as one who calls, hypnotizes us with words and personality and leaves with our order. His purpose is to make the immediate sale and the largest possible profit from it.

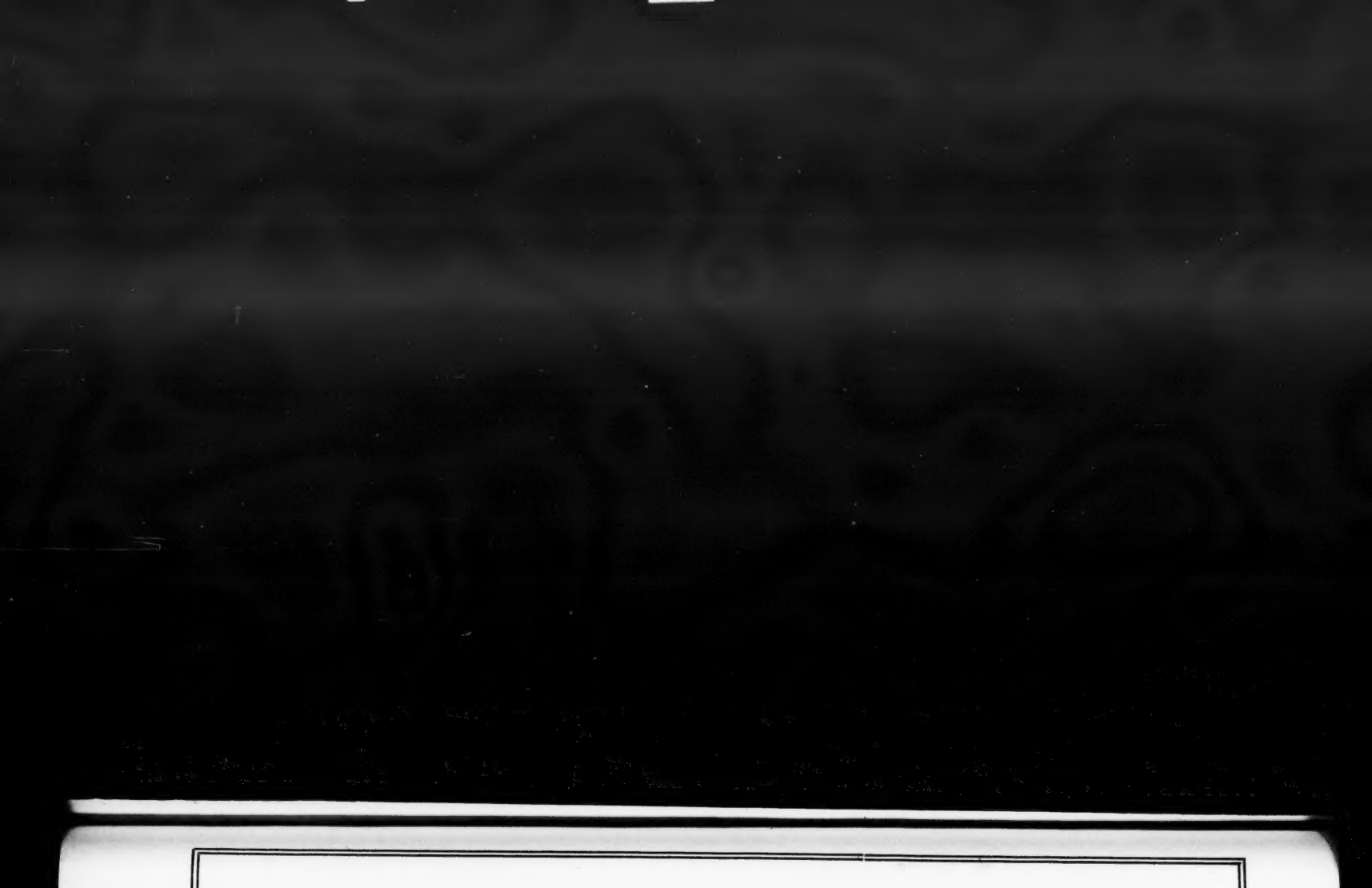
While go-getting qualities are indicative of admirable energy, they are sometimes found in connection with merchandise hardly safest for us to buy. The salesman we should welcome is one who represents a house, managed by a sales-statesman.

A sales-statesman has a view that extends far beyond the one immediate sale; therefore, he plans not so much for a large profit from the single sale as for building into his business methods a quality and satisfaction that will form the foundation for future business.

A thought in this connection is that the steady, consistent advertiser is always a sales-statesman. He cannot be otherwise.

The purpose of his advertising is to aid in obtaining new customers from whom repeat orders will be received. He depends on the accumulative profits from these repeat orders to repay the cost of his advertising and his eventual net profits.

It is plain, then, that any advertising campaign, to be permanently successful, must be built on the satisfaction given by the product advertised, by honest business methods and by a considerate service to the buyer.

The advertisements in this issue of THE JOURNAL OF THE AMERICAN DENTAL ASSOCIATION are messages of sales-statesmen. The products advertised are good products.

In buying from the advertising columns of this paper, there is safety and value insured.